

Report of the Work of The Rubber Research Board in 1938.

(Established under Ceylon Ordinance No. 10 of 1930).



March, 1939.

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The present report is the 8th Annual Report of the Rubber Research Scheme (Ceylon) as constituted under Ordinance No. 10 of 1930.

The provisions of the Ordinance are subject to the following amending Ordinances :—

No. 11 of 1934—Provides that raw rubber brought into the island for the purpose of re-export shall not be liable for payment of the cess under the Rubber Research Ordinance.

No. 35 of 1935—Provides for transfer of the lease of Nivitigalakele to the Rubber Research Board.

No. 3 of 1936—Provides that the Board may apply for, purchase or otherwise acquire patents, brevets d'invention, concessions and the like.

CHAIRMAN'S REPORT

Board Membership.—The three-year period of office of the following nominated members of the Board terminated during the year and appointments to fill the vacancies were made as indicated below :—

Mr. E. C. Villiers, February 16th. Renominated for a further period of three years.

Mr. B. M. Selwyn, July 10th. Renominated for a further period of three years.

Mr. E. W. Whitelaw, December 14th. Renominated for a further period of three years.

The following additional changes in the membership of the Board occurred during the year :—

Mr. C. E. Jones continued to represent the Financial Secretary from the beginning of the year until the return of Mr. C. H. Collins on 20th August.

Col. T. Y. Wright resigned and Mr. L. P. Gapp was nominated in his place with effect from 1st April.

Mr. E. C. Villiers resigned on April 30th, and Mr. R. P. Gaddum was nominated in his place with effect from June 20th.

Mr. J. C. Kelly was on leave from April 27th to December 6th and Mr. R. A. Sharrocks was nominated to act for him.

Mr. I. L. Cameron was on leave from January 22nd to July 15th and Mr. R. J. Hartley was nominated to act for him.

Mr. E. Rodrigo was on leave from 1st December and Mr. F. P. Jepson, Acting Director of Agriculture, assumed duties as Chairman of the Board from that date.

Prior to the resignation of Col. T. Y. Wright the Chairman expressed the gratitude of the Board for his services over a number of years. He had been a member of the Board from its inception in 1930 and of the Executive Committee of the old Rubber Research Scheme since December, 1920. A vote of thanks to Col. Wright was adopted with applause.

The personnel of the Board at the end of 1938 was as follows :—

Ex-Officio Members.

The Acting Director of Agriculture (F. P. Jepson, Esq.), Chairman.

Representing the Financial Secretary—The Deputy Financial Secretary (C. H. Collins, Esq., C.C.S.).

Unofficial Members of the State Council nominated by H.E. the Governor.

G. E. de Silva, Esq., M.S.C.

R. P. Gaddum, Esq., M.S.C.

R. C. Kannangara, Esq., M.S.C.

Nominated by the Ceylon Estates Proprietary Association.

J. C. Kelly, Esq.

L. P. Gapp, Esq.

Nominated by the Planters' Association of Ceylon.

F. H. Griffith, Esq., M.S.C.

B. M. Selwyn, Esq.

Nominated by the Rubber Growers' Association.

I. L. Cameron, Esq.

E. W. Whitelaw, Esq.

Nominated by H.E. the Governor to represent Smallholders.

F. A. Obeyesekere, Esq.

C. A. Pereira, Esq.

Nominated by the Low-Country Products Association of Ceylon.

L. B. de Mel, Esq., J.P., U.P.M.

L. M. M. Dias, Esq.

Col. T. G. Jayewardene, V.D.

J. L. D. Peiris, Esq.

Meetings.—Meetings of the Board were held at Dartonfield on January 26th and at Colombo on March 24th, June 10th, September 8th, and October 27th. The Board is indebted to the Ceylon Chamber of Commerce for the use of its Committee Room for meetings held at Colombo.

Committees.—

Experimental Committee.—The personnel of the Committee during the year was as follows :—

Mr. F. H. Griffith (Chairman).
Col. T. G. Jayewardene, V.D.
Mr. F. A. Obeyesekere.
Mr. B. M. Selwyn.
The Director (Convenor).

Meetings of the Committee were held at Dartonfield on February 24th, March 14th, May 2nd, August 15th, October 4th, and December 19th.

Smallholdings Committee.—The personnel of the Committee remained as follows :—

Mr. F. A. Obeyesekere.
Mr. C. A. Pereira.
The Smallholdings Propaganda Officer.
The Director (Chairman and Convenor).

A meeting of the Committee was held in Colombo on August 27th.

“ Ad Hoc ” Committees.—A meeting of the Committee appointed to consider the terms of service of the Secretary to the Director was held on 9th January.

London Advisory Committee.—The Board continued to contribute jointly with the Rubber Research Institute of Malaya to the cost of research on the quality of raw rubber carried out at the Imperial Institute, London, under the control of the London Advisory Committee for Rubber Research (Ceylon and Malaya). The Board's contribution during the year amounted to £875 which represents 25 per cent. of the total cost of the work.

The London Advisory Committee held meetings on 28th January, 29th April, and 30th September. Meetings of the Technical Sub-Committee were held on 28th January, 29th April, and 14th October.

FINANCE

Income.—The Board's income is mainly derived from the cess of 1/8 cent. per lb. levied on exports of rubber under the Rubber Research Ordinance. Exports fluctuate according to the releases allowed under the International Rubber Regulation agreement and the substantial reduction of the export quota which took effect from January, 1938, necessitated the preparation of revised estimates of income and expenditure early in the year. Total income amounted

to Rs. 179,230·36, compared with an original estimate of Rs. 228,000 and a revised estimate of Rs. 177,719.

The following statement shows the Board's annual income for the period during which exports have been regulated under the international agreement :—

			Income from the Cess		Income from other sources		Total		
			Rs.	c.	Rs.	c.	R.	c.	
1934	...	...	220,403	20	...	25,765	53	246,168	73
1935	...	...	154,395	61	...	18,950	97	173,346	58
1936	...	...	140,533	02	...	37,153	28	177,686	30
1937	...	...	191,984	89	...	38,505	29	230,490	18
1938	...	...	149,323	92	...	29,906	44	179,230	36

Monthly cess collections during 1938 were as follows :—

January...	...	...	...	...	...	Rs. 23,494	21
February	...	...	...	...	...	„ 14,885	23
March	...	...	...	...	...	„ 10,854	03
April	...	...	...	...	...	„ 5,492	68
May	...	...	...	...	...	„ 7,278	85
June	...	...	...	...	...	„ 10,540	68
July	...	...	...	...	...	„ 11,198	09
August	...	...	...	...	...	„ 12,064	29
September	...	...	...	...	...	„ 12,407	77
October	...	...	...	...	...	„ 12,126	91
November	...	...	...	...	...	„ 18,167	05
December	...	...	...	...	...	„ 10,814	13

Rs. 149,323·92

The Board will benefit very materially from the increased basic quota allotted to Ceylon under the revised regulation agreement which took effect from 1st January, 1939.

A profit of Rs. 18,851·08 was derived from the normal working of Dartonfield Estate and Rs. 5,099·58 from Nivitigalakele Experiment Station.

Expenditure.—Current expenditure amounted to Rs. 165,649·04, leaving a surplus for the year of Rs. 13,581·32. Capital expenditure amounted to Rs. 51,968·68, including the following items :—

Balance payments for buildings erected in 1937, Rs. 5,901; part payment for Soil Chemist's Bungalow, Rs. 18,127; three junior staff bungalows, Rs. 9,055; Water and Power Scheme, Nivitigalakele, Rs. 2,338; Experimental Machinery, Rs. 4,903. A sum of Rs. 1,868 was expended on agricultural development at Nivitigalakele and Rs. 2,407 at Dartonfield.

Accounts.—The accounts of the Scheme have been audited by the Auditor-General and his report, together with a balance sheet and statement of income and expenditure, are attached. The form of accounts is now similar to that adopted by the Tea Research Institute and the Coconut Research Scheme.

TECHNICAL REPORTS

The reports of the Director, Chemist, Botanist and Mycologist, Smallholdings Propaganda Officer and Estate Superintendent are also attached.*

(Sgd.) F. P. JEPSON,
Chairman of the Board,
Rubber Research Scheme (Ceylon).

21st February, 1939.

* The report of the London Advisory Committee for Rubber Research (Ceylon and Malaya) is also attached.

DIRECTOR'S REPORT FOR 1938.

STAFF

The scientific staff was enlarged during the year by the appointment of a Soil Chemist and a Geneticist, bringing the staff up to the full establishment contemplated under the Board's programme of development. The effect of the increase of staff on the organisation and activities of the Scheme's work on the agricultural side is discussed in some detail in the report of the Botanist and Mycologist.

Director.—Mr. T. E. H. O'Brien was in charge of the work of the Scheme during the year.

Chemical Department.—Mr. M. W. Philpott, Chemist, was away from the Island on leave from April 13th to November 14th. Advisory correspondence and certain experimental work was undertaken by the Director during his absence.

Botanical Department.—Mr. R. K. S. Murray, Botanist and Mycologist, and Mr. C. A. de Silva, Assistant Botanist, were on duty during the year.

Dr. C. E. Ford, B.Sc., Ph.D. (Lond.), was appointed to the post of Geneticist and assumed duties on 31st May, 1938.

Soils Department.—Dr. L. A. Whelan, M.Sc. (N.Z.), Ph.D. (Aber.), A.I.C., was appointed to the post of Soil Chemist and assumed duties on 31st October, 1938.

Smallholdings Department.—Mr. W. I. Pieris, Smallholdings Propaganda Officer, was on duty during the year.

Estate and Experiment Station.—Mr. D. L. Nicol, Estate Superintendent, was in charge of Dartonfield and Nivitigalakele during the year.

BUILDINGS

One senior and one junior staff bungalow were constructed at Dartonfield and one junior staff bungalow at Nivitigalakele. The building programme entailed in the establishment of the Scheme's headquarters at Dartonfield has now been virtually completed. One junior staff bungalow is to be constructed in 1939 and an additional senior staff bungalow will be required later. At Nivitigalakele a field laboratory will be constructed in 1939 for the use of the Geneticist.

A statement of the expenditure on the construction and equipment of the buildings comprising the new headquarters was prepared recently for the information of the Board and a summary is attached to this report as being of general interest. Credit for carrying out the building programme on a very moderate basis of expenditure is mainly due to the members of the Experimental Committee.

A summary of the year's activities is given below and further particulars are available in the departmental reports which are attached.

CHEMICAL DEPARTMENT

Owing to the absence of the Chemist on leave for a large part of the year the activities of the department were correspondingly restricted.

Vulcanised Products.—The manufacture of a few small vulcanised products (erasers, tubing, table mats, squeegee rubbers) on a semi-commercial scale at Dartonfield experimental factory was continued during the year, as a demonstration of the practicability of local manufacture of such products. The Board's programme of work on this subject is now considered to have been satisfactorily completed and the work was discontinued at the end of the year.

A student, nominated by the Minister for Labour, Industry and Commerce, was given seven months' training in the technology of rubber manufacture.

Latex.—World consumption of latex was substantially lower in 1938 than in the previous year. This was probably attributable to general economic conditions and it seems probable that there will be a steady expansion in the demand for this class of material. The main patents controlling the concentration of latex by chemical creaming and centrifuging have now expired in Ceylon and will expire in most rubber consuming countries within the next two years. Experimental work was undertaken on the technological aspects of latex concentration by these methods with a view to interesting local producers in the possibilities of this form of manufacture.

There were a number of enquiries from India for creamed (58-60 per cent.) latex and several consignments were shipped from Dartonfield during the year. It was found from a series of trials that a minimum period of four days should elapse between ammoniation and creaming. Interesting results were obtained in laboratory experiments to compare the efficiency of the creaming process in vessels of different shapes.

Centrifuging trials were carried out in the latex separator which was installed last year. From a study of the working of the machine under a variety of conditions it was established that whereas, for a fixed setting of the jet and skim screws, the efficiency of separation improves as the latex matures, it was possible, by suitable adjustment, to prepare latex of 60 per cent. D.R.C. on the day after collection. The machine under trial had a relatively low efficiency as judged by the rubber content of the skim fraction, but proved quite suitable for experimental work.

It was found that the skim fraction could be recentrifuged to give a product containing 50-55 per cent. rubber, or concentrated by creaming to 35-40 per cent. D.R.C. Both products contain an accumulation of the smallest rubber particles, and may prove to be of economic interest for special purposes.

An experiment to compare the changes in dry rubber content and ammonia content which occur during the storage of preserved latex under tropical and temperate conditions is being carried out in conjunction with the London Advisory Committee. Samples stored at Dartonfield were examined at intervals of six months from the time of preparation and particulars are recorded in the Chemist's report.

Purified Rubber.—Rubber which has been purified by the partial removal of protein and other non-rubber substances is required by cable manufacturers and others owing to the reduced tendency of such material to absorb moisture. Purified rubber is already commercially available and there would probably be an increased demand if it could be produced at a lower cost than at present.

Trials were started to determine the degree of purification which can be effected by different methods, with a view to the selection of a treatment or series of treatments which can be readily adapted to present estate practice.

Variability of Raw Rubber.—Reference was made in last year's report to the decision reached by the Board to undertake investigations on the variability of raw rubber. An autoclave vulcanising press was installed early in the year, but the programme of work could not be started until November owing to a defect in the mechanism of the press.

Nitrite Crumb Rubber.—Further trial areas of roadway surfaced with bitumen containing a small proportion of nitrite crumb were laid in England during the year. None of the areas has been laid long enough to enable definite conclusions to be formed regarding the effect of the rubber but, on the whole, the evidence indicates that it improves the non-skid properties of the surfacing material.

Nitrite crumb tends to mass during storage and trials of alternative dusting materials were undertaken. They were all found to be inferior to the present treatment of dusting with 3 per cent. of zinc stearate.

Chlorinated Rubber.—Chlorination trials on fresh and ammoniated latex were carried out according to the method suggested by the staff of the London Advisory Committee, except that it was found more convenient to work with flocculated latex than with untreated material. The products were similar in type to those obtained in trials with more mature latex and it was again found that a large excess of reagents was required for the formation of a product of a given chlorine content.

Meteorological Records.—At the request of the Superintendent, Colombo Observatory, arrangements were made to forward a daily telegraphic summary of weather observations for inclusion in the weather report issued by the observatory. Similar records are supplied by the Tea and Coconut research organisations.

London Advisory Committee for Rubber Research (Ceylon and Malaya).—Mr. W. S. Davey, Chemist on the Committee's staff at the Imperial Institute, London, visited the main rubber-producing countries during the year

and spent one week in Ceylon under the auspices of the Research Scheme. During his stay the opportunity was taken to make a detailed examination of the rubber-testing methods in use at Dartonfield with a view to bringing them strictly into line with those followed at the Imperial Institute. Mr. Philpott, whilst on leave in England, made a study of the same subject in the course of several visits to the Committee's laboratories.

A number of samples of latex, crumb rubber, and purified rubber were submitted to the Committee for examination.

We are greatly indebted to the Committee for their assistance in the selection of a Soil Chemist and to the Secretary for his services in connection with the supply of equipment and chemicals.

BOTANICAL AND MYCOLOGICAL DEPARTMENT

As in previous years the report of the department includes an account of such work on soils problems as has been undertaken. This branch of work will be taken over and extended by the newly constituted Soils Department in 1939.

Oidium Leaf Disease.—It has been established from observations in previous years that the incidence of Oidium in low-country districts is mainly dependent on the weather conditions which prevail during and before the refoliation period. This was well illustrated in 1938 when the occurrence of cool, dull, wet weather during February and March resulted in an exceptionally severe incidence of the disease. Sulphur dusting programmes were undertaken on many low-country estates, but the degree of control was mostly very poor, owing partly to the sulphur being washed off the leaves by heavy rain and partly, probably, to the lower efficiency of the sulphur in the absence of sun. At high elevations where the disease always causes serious damage there was similar interference with dusting operations and very severe defoliation occurred.

The relative failure of sulphur dusting during the season came as a great disappointment to mid-country planters and led to a demand for further research with a view to discovering a more effective method of controlling the disease. It is very unlikely that a more efficient fungicide than sulphur could be employed even if the important factor of cost was ignored. There may, however, be scope for the improvement of existing methods of application and looking to the far future, there is the possibility of resistant clones being developed. Proposals were adopted by the Board for a limited programme of research on the following lines :—

- (1) Development by selection and/or breeding of resistant clones.
- (2) Field trials of promising brands of dusting sulphur.
- (3) Tests of various substances as adhesives.

Root Disease.—Reference was made in last year's report to the occurrence of root disease in replanted clearings in areas where there was no previous history of disease. It is now a matter of general experience that such outbreaks are

liable to occur and it was thought desirable to issue a questionnaire to ascertain the present position on estates where replanting operations are being undertaken. Replies were received from 156 such estates, representing a large proportion of the total acreage which has been replanted in recent years. The total number of cases of root disease amounted to approximately 0.1 per cent. of the trees planted. On 17 estates selected as having a high incidence of disease there was a loss of more than one plant for every five acres. More than one-third of the total casualties occurred on a single estate.

The general position disclosed by the replies to the questionnaire is very reassuring, but it is clear that serious losses among the young trees may occur in individual instances. The view that the treatment of outbreaks as they occur will prove less expensive than complete root removal before replanting has been modified to the extent that it is now suggested that all the larger lateral roots should be removed when replanting is undertaken in localities in which *Fomes* is known to have caused widespread damage.

It is proposed to issue a similar questionnaire at annual intervals for the present with a view to maintaining close touch with developments.

Minor Diseases and Pests.—Bird's-eye-spot (*Helminthosporium Heveae*) continued to give trouble in nurseries. In an experiment with various spray fluids the results were almost entirely negative, only sulphur powder being found to exercise any appreciable control. Weekly rounds of sulphur dusting and the application of fertilisers to promote vigorous growth are the best available means of dealing with the disease.*

There were numerous reports of damage to the roots of young seedlings and transplanted stumps by the grub of the cockchafer beetle [*Leucopholis (Lepidiota) Pinguis*.] The pest is causing considerable concern on individual estates, but, up to the present, its effects appear to be less serious than those of the related species, *Psilopholis vestita* in Malaya. Control by the use of carbon bisulphide as a soil fumigant has been recommended to estates and appears to be an effective, though expensive treatment.

Planting Material.—An area of ten acres at Nivitigalakele which is being cleared for planting in 1939, is to be laid out with test plots of new clones, most of which will be established from high yielding mother trees derived from Tjikadoe seed.

Interesting results were obtained from a small experiment started at Nivitigalakele in 1927 to study the possible effects of stock on scion in respect of growth and yield. Comparison of yield data for a period of three years showed a positive correlation for the effect of stock on scion, which increased as the tapping cuts approached the union. Another experiment was laid down at Peradeniya in 1930 to compare the growth and yield of a number of local clones budded (a) on to stocks derived from illegitimate seed from the respective mother trees, and (b) on to mixed stocks. Girth measurements taken in 1938 showed that, in general, there was no difference in the rate of growth.

* Since this report was written experiments with artificial light shade over the nursery beds have given encouraging results.

Test tapping of local clones was continued at Nivitigalakele, Wagolla, and on various estates co-operating with the Scheme. A total of 104 clones were tapped at Nivitigalakele in 1938, the highest yield being given by clone Wagga 6278 which produced 13 lbs. per tree at the age of 8 years. Records of the test tapping of imported clones were received from the Experiment Station, Peradeniya, from Wagolla and from a number of estates in different districts. Reports on the yield of local and imported clones during 1937 were published in 2nd Quarterly Circular for 1938.

Arising from the unsatisfactory results obtained with shipments of budwood of the Pilmoor clones from Malaya to Ceylon in 1937 assistance was given, in co-operation with the Rubber Research Institute of Malaya, in an experiment to trace the causes of failure. From the budding results of an experimental shipment of budwood taken from three different sources it was concluded that, for shipment involving storage for seven days or more, the budwood should be considerably more mature than for local use. No special difficulties have arisen in the importation of budded stumps of the clones concerned.

Tapping.—The first year of the experiment to compare a number of different tapping systems in the mature Rubber on Dartonfield was completed in February, 1938. The relative yields under the various systems were much as expected, but full comparisons cannot yet be made as some of the rotational systems have not completed a full cycle. The rate of bark renewal was satisfactory under all systems and the differences were very slight.

The girth figures of a number of tapped and untapped budded trees at Nivitigalakele were compared to ascertain whether the rate of girth had been retarded by tapping. No appreciable difference was found in the rate of growth between the sixth and eighth years.

A small experiment was started at Nivitigalakele to compare different rates of bark consumption for budded trees. The rates under trial were $\frac{1}{2}$ inch, $\frac{3}{4}$ inch, and 1 inch per month on half spiral alternate day tapping. At the end of nine months' tapping the treatment differences were not statistically significant.

Proposals are under consideration for a series of tapping experiments on estates with the object of determining the most suitable tapping systems for budgrafts of the imported clones in general use.

Manuring.—The manuring experiment in mature rubber at Dartonfield had been in progress for three years at the end of 1938. The results for 1937, the first year after the initial application of fertilisers, were published in 1st Quarterly Circular for 1938 and a summary is given in the Botanist's report. There was a yield response to manuring which was just significant on the 20:1 basis of probability, but the figures are taken with some reserve owing to the control plots having a lower initial yield than the treated plots, as the result of an unfortunate random distribution. There was no significant difference in the rate of girth increase (average 0.61 inches) or in the bark renewal (average 4.8 mm.).

Advice was given to a number of estates wishing to lay down manuring experiments in replanted clearings and several such trials have been started. The experiments should provide valuable information on the fertiliser requirements of young buddings in different localities.

Girth measurements were made in the experiment in the 1935 clearing at Pinnagoda to compare compost manure with an artificial fertiliser mixture of corresponding nutrient content. There was no significant difference in the rate of growth under the two treatments. The average girth increase (2.36 inches) was low owing to the inclusion of a particularly poor area of land in the experimental block. A further application of fertilisers was made and on this occasion phosphate was added to the compost to provide a better balanced mixture.

Natural Covers.—The area of 20 acres at Dartonfield which was set aside in 1936 for observations on the so-called forestry system of cultivation was forked and manured early in the year owing to the slow rate of development of the natural covers and there has since been some improvement in the rate of growth. A six-foot strip was cleared down each row of trees and a species of grass which was becoming troublesome was also controlled.

Replanting Experiments at Dartonfield.—A report on the progress of the three experimental areas was published in 3rd Quarterly Circular for 1938 and the figures are also reviewed in detail in the Botanist's report.

Area No. 1 (1934) has as its main object a comparison of the effects of four species of creeping cover on the development of the trees. After four years, growth in the vigna plots is slightly better than in those with more vigorous covers but, during the fourth year, the biggest girth increase was in the *Pueraria* plots.

As forecast in last year's report area No. 2 which was laid out in 1935 for a comparison of fertiliser treatments was replanted in 1938 and an additional area of six acres was brought into the experiment to increase the number of replications to six. The fertiliser treatments were varied in order to allow for a comparison of potash and phosphoric acid in the absence of nitrogen. A compost treatment was also included.

Area No. 3 (1936) provides comparisons of three methods of opening the land, three methods of planting, and the effects of manuring with organic and inorganic mixtures. At the present stage of the experiment the stumped buddings are, as would be expected, substantially larger than the budded stumps which, in turn, are well ahead of the plants budded in the field. It remains to be seen how the different forms of material will develop in the next few years. The data in regard to methods of opening cannot yet be submitted to a combined analysis as the field buddings were measured in terms of height. On the basis of the figures for stumped buddings and budded stumps growth in the platformed and trenched areas was superior to that in the contour drained areas. There was no difference in the growth in areas manured with organic and inorganic mixtures.

SMALLHOLDINGS DEPARTMENT

The work of the department was extended during the year to all the main Rubber growing districts. There are now six rubber instructors stationed respectively at Matugama, Horana, Ruanwella, Ratnapura, Katugastota and Galle. The new instructors were given a course of approximately three months' training before being posted for duty. Some inconvenience was caused by the resignation of one instructor during the period of training and another a few months afterwards, necessitating special training being given to the officers appointed to replace them.

Owing to the low price of uncouponed rubber in the first half of the year very little tapping was done on smallholdings during this period, thus limiting the scope for tapping and sheet-making demonstrations, etc. In the latter months of the year tapping was resumed and a considerable amount of interest was taken by smallholders in the possibility of obtaining improved prices for well made sheets. The price level at which it pays smallholders to tap appears to be about six cents per lb.

Demonstrational smokehouses of the type recommended by the department were constructed in each of the new ranges and there is now a total of 13 such smokehouses in the six ranges. Experience has confirmed that sheet of very good appearance can be prepared in the houses. The Smallholdings Propaganda Officer records that assistance has been given in the construction by smallholders of 25 similar houses. A leaflet on the preparation of smoked sheet was prepared and issued.

Increased interest was taken in replanting and the instructors were of service to smallholders both by giving assistance and advice in the practical work and by assisting in the preparation of application forms for replanting permits. Similar assistance was given in connection with application forms for new planting permits. The correct completion of official returns is a matter of considerable difficulty to uneducated peasants and the assistance of the Rubber Instructors in preparing applications for replanting permits and other returns connected with rubber control has been of substantial value to smallholders. A revised edition of the leaflet on replanting of rubber was prepared and issued.

In each of the new ranges and in the Matugama district a demonstration area of approximately half acre was replanted with budgrafts of approved clones. Two similar areas were established in the Horana range last year. The growth in one of them was very good; in the other the plants are backward owing to neglect of weeding on the part of the proprietor.

Two competitions were conducted in the Horana range, one for the best kept smallholding and the other for the best smoked sheet. The Director undertook the final judging early in the current year and was impressed with the high standard of work on a number of the holdings. Tapping in particular was very good and there is little doubt that the general standard of tapping on smallholdings is considerably higher than it was a few years ago. It will, however,

be difficult to wean the smallholder from the practice of daily tapping which is the common practice. The best of the smoked sheet samples were well up to estate quality and it is gratifying to record that the smallholders concerned stated that they could secure an extra 1—1½ cents per lb. by making good sheet.

The department participated in two agricultural exhibitions, one at Tel-deniya and one at Ruanwella. The exhibitions provide useful contact with smallholders and it is proposed to support one such exhibition annually in each of the ranges.

It was decided by the Board that budwood and budded stumps would, in future, only be supplied to persons who come within the purview of the smallholdings department, *i.e.*, the proprietors of Rubber lands not exceeding a total area of 30 acres. Control of the issue of the material was handed over to the Smallholdings Propaganda Officer who has allocated approximately 9,000 budded stumps and 500 yards of budwood for delivery in the S.W. planting season of 1939.

Samples of coagulants were obtained from a number of village dealers in the Kalutara district and examined by the Chemist. In most cases the material proved to be either formic or acetic acid of satisfactory quality and price. There were a few instances of adulteration, incorrect description, or overcharging.

The question of providing improved marketing facilities for village rubber was discussed with the Commissioner for the Development of Agricultural Marketing, who considered that the most promising method of effecting an improvement would be by the appointment of "approved dealers," who would handle the rubber on a commission basis and pay for it according to the price realised in Colombo. The system was stated to have given good results in the marketing of cocoa in the Kandy district. The Commissioner has agreed to consider the inauguration of a scheme on these lines when market conditions are favourable.

DARTONFIELD ESTATE

Crop for the year amounted to 71,218 lbs., representing a yield of 584 lbs. per acre on the tapped area. Tapping was on the double-four system which continues to prove satisfactory under the conditions prevailing on the estate.

The property was re-surveyed and a plan prepared showing the position of roads, buildings, experimental and replanted areas. The area occupied by buildings and roads is slightly under 15 acres.

Abnormal weather conditions which approximated to a reversal of seasons as far as rainfall is concerned, were not without effect on the working of the estate. Wet weather prior to and during the refoliation season led to a severe attack of *Oidium* and interfered with its control by sulphur dusting. Owing to shortage of rain in June it was necessary to water the stumps in the newly replanted areas. There was also a falling off in crop during this period, whilst rains in August-September interfered with tapping operations. The slight

reduction in crop for the year can probably be attributed to the nett shortage of rainfall and the effects of *Oidium*. On the credit side, however, it should be mentioned that there was practically no *Phytophthora* leaf-fall.

The crop was mainly prepared in the form of blanket crepe and sold on the local market. Small quantities of smoked sheet, ammoniated latex and nitrite crumb were also prepared.

Half the mature area of the estate was manured with a mineral fertiliser mixture in accordance with the programme of biennial manuring. There is now a good cover of *Pueraria* in parts of the estate and it is spreading satisfactorily in others. Areas in the vicinity of lines were re-supplied.

An area of 19 acres was replanted according to experimental requirements. The superintendent was responsible for the practical side of this work and for the upkeep of other replanted areas. There were six new cases of root disease in the ten acres area replanted in 1936, making a total of nine cases in this field.

The Visiting Agent, Mr. P. R. May, inspected the estates on 29th April. Mr. D. T. Angus was appointed Acting Visiting Agent during the absence of Mr. May on leave, and inspected the estates on 30th August. Both reports were very satisfactory.

NIVITIGALAKELE

Crop for the year amounted to 17,914 lbs., representing a yield of 453 lbs. per acre on the area in tapping. The crop was prepared partly as smoked sheet and partly as scrap crepe remilled at Dartonfield from test tapping samples.

The effects of *Oidium* were less severe than at Dartonfield, probably owing to the more rapid refoliation of the young trees. It is of interest to record that there has only been a single case of root disease at the station up to the present.

A mineral fertiliser mixture was applied to the 1926, 1927 and 1928 clearings at the rate of 200 lbs. per acre. A small backward area received an additional application. In the 1935 clearing at Pinnagoda two fertiliser applications were made except in the area reserved for the compost experiment. Nurseries were manured according to requirements. Growth in the Pinnagoda area is distinctly backward for the age of the plants.

Approximately 3,500 yards of budwood and 7,500 budded stumps were issued. Regulations for the introduction, multiplication and distribution of planting material were adopted by the Board and put into force with a view to reducing the risk of errors to a minimum. As from 1939 planting material will only be supplied to smallholders, except that special arrangements are being made for supplying small quantities of budwood of promising local clones to estates.

Thirteen courses of training in budgrafting were held. Each course lasted ten days and the total attendance was 139. The students were mainly estate

employees of the conductor class, but a certain number of selected youths, unemployed conductors, etc., were also trained. The majority of the students attained a satisfactory standard of proficiency.

WAGOLLA

A crop of 2,083 lbs. was obtained from the 197 trees in tapping. The crop was in the form of individual test tapping samples which were remilled at Dartonfield.

Monthly supervisory visits were made by the Nivitigalakele conductor and the Estate Superintendent made two visits to the area.

Lateral and leader drains were cut during the year. The area was originally contour platformed but the water-holding capacity of the platforms had been reduced to zero owing to lack of attention in previous years. *Pueraria* has spread well in most parts.

ADVISORY SERVICES

Heavy demands were made on the Botanical department for advisory services during the year. It will be seen from the figures given in the Botanist's report that there was an increase in the number of enquiries on all agricultural subjects compared with the previous year. The subjects on which advice was mainly called for were : budding and allied subjects, manuring, *Oidium* and other pests and diseases.

Evidence of mixing of clones on estates led to requests for advisory visits which could not be met without undue interference with other work and the Rubber Research Institute of Malaya assisted us by the loan of an experienced Chinese budding mandor for several months to undertake the checking of clones on estates. The officer had visited 90 estates up to the end of the year and a further 34 visits were made before his return to Malaya early this year. This work has been of the greatest value to the local industry and we are extremely grateful to the Malayan Institute for their practical co-operation.

Advice was given to the Director of Agriculture on the establishment of budwood multiplication nurseries for the supply of material to middle class and peasant proprietors who receive permits under the Rubber (New Planting) Ordinance, 1938, and also on the organisation required for giving practical advice and assistance to such proprietors. In accordance with the proposals adopted by Government the Research Scheme undertook to compile a manual of instruction on new planting. The preparation of the first part of the manual was nearing completion at the end of the year.

On the manufacturing side there is little of special interest to record, since shortage of available funds arising from the reduction of the export quota led, in many cases, to the postponement of proposals for factory improvement. There were, however, indications of interest in the provision of improved coagulating equipment which can be installed at a relatively low cost. Representations

were made to the Ceylon Estate Proprietary Association, The Low-Country Products Association and the Planters' Association of Ceylon on the undesirability of the continued use of brass mesh for straining latex and it is understood that there has since been a substantial demand for monel and nickel gauze from local suppliers.

There were 155 visitors to Dartonfield during the year according to the visitors' book, which probably does not give quite a complete record. This figure does not include the attendance on the Field Day held in conjunction with the Rubber Conference which is referred to in a later paragraph, and a party of 18 students from the Farm School and Experiment Station, Peradeniya. Among notable visitors were Mr. Vanden Abeele, Belgian Colonial Office; Dr. C. M. Crowther, Rothamsted Experiment Station; Mr. C. H. Figg, Chairman, Ceylon Association in London; Mr. G. Brown, London Advisory Committee for Rubber Research (Ceylon and Malaya); Sir Frank Stockdale, Agricultural Advisor to the Secretary of State for the Colonies; Dr. F. Crowther, Sudan Department of Agriculture; Mr. E. Bateson, Late Rubber Advisory Officer, British North Borneo.

MEETINGS, COMMITTEES, ETC.

The Director was present at meetings of the Rubber Research Board by invitation and served on the Experimental Committee and Smallholdings Committees.

The Director is an ex-officio member of the Central Board of Agriculture and continued to serve on the Board for the special assessment of Budded Rubber. Mr. R. K. S. Murray was nominated to serve on the Department of Agriculture Committee for the compilation of a manual on weeds.

A very successful Rubber Conference arranged by the Kalutara Planters' Association on behalf of the Planters' Association of Ceylon and with the co-operation of the Rubber Research Board, was held at Tebuwana on November 25th. On the following day a Field Day was arranged at Dartonfield. There was an attendance of 192 at the Conference and 51 at Dartonfield. The following papers were read at the Conference by Research Scheme officers:—

“The Budgraft as a Composite Plant.” R. K. S. Murray.

“Modern Development in the Preparation of Plantation Rubber.”
T. E. H. O'Brien.

“The Principles and Application of Plant Breeding Methods.” C. E. Ford.

“The Smallholdings Department of the Rubber Research Scheme.”
W. I. Pieris.

“Oidium Leaf Disease.” R. K. S. Murray.

Addresses to District Planters' Associations were given as follows:—

Director: “The Quality of Plantation Rubber.” Sabaragamuwa Planters' Association.

Botanist and Mycologist: "Root Disease with Special Reference to Re-planting." Sabaragamuwa Planters' Association.

"The Care of Young Budded Trees." Southern Province Planters' Association.

"The Choice of Clones for Dry Districts." Kurunegala Planters' Association.

Geneticist: "The Identification of Clones." Kelani Valley Planters' Association.

The Director attended the annual general meeting of the Planters' Association of Ceylon.

CO-OPERATION WITH OTHER RESEARCH ORGANISATIONS

Mr. H. J. Page, Director, Rubber Research Institute of Malaya, was able to spend a few hours at Dartonfield when passing through Ceylon recently. A similar visit was made by Mr. C. C. T. Sharp, Botanist at the Institute. Mr. T. N. Dickson, Assistant Manager of the Institute's Experiment Station, made a stay of two days. Mr. J. Wilson, Director of Research, British Rubber Producers' Research Association was met in Colombo when he passed through on his return from a tour of eastern rubber-producing countries. Such opportunities for personal contact with officers of other research organisations are always welcomed and are of undoubted value in maintaining active co-operation.

As in previous years there was a regular exchange of reports with the Rubber Research Institute of Malaya and the Rubber Growers' Association. Assistance was given to the British Rubber Producers' Research Association by the selection of a Ceylonese graduate for training in the Association's laboratories and by the provision of latex and rubber samples.

Publications were exchanged with a number of scientific organisations in different parts of the world.

PUBLICATIONS

Publications of the Research Scheme are issued without charge to the proprietors (resident in Ceylon), Superintendents and Local Agents of rubber estates over ten acres in extent, who apply for registration. There were 665 estates and agencies on the register at the end of the year, together with 39 subscribers who were not eligible for free issues.

Publications issued during the year were as follows:—

Annual Report and Accounts, 1937.

1st Quarterly Circular—

Field Experiments on Dartonfield Estate—VI. Manuring Experiment with Mature Rubber. R. K. S. Murray and C. A. de Silva.

Planting Notes. R. K. S. Murray.

Planting Material. R. K. S. Murray.

Root Disease with Special Reference to Replanting. R. K. S. Murray.

2nd Quarterly Circular—

The Performance of Imported Clones in Ceylon—II. R. K. S. Murray.

Ceylon Clones—VI. R. K. S. Murray.

The Experimental Manufacture of Vulcanised Products at Dartonfield.
M. W. Philpott.

3rd Quarterly Circular—

Field Experiments on Dartonfield Estate—VI. Measurements of
Growth in Replanted Areas. R. K. S. Murray.

Practical Compost Making on Estates. H. W. Starling.

The Care of Young Budded Trees. R. K. S. Murray and C. A. de Silva.

4th Quarterly Circular—

Proceedings of the Rubber Conference, November 25th, 1938.

(Sgd.) T. E. H. O'BRIEN,
Director.

Research Laboratories,
Agalawatta.

25th February, 1939.

RUBBER RESEARCH SCHEME (CEYLON).

Cost of Buildings.

	Site Cutting Rs.	Building Rs.	Water Supply and Drainage Rs.	Electric Light and Power Rs.	Furniture and Fittings Rs.	Machinery and Tools Rs.	Gas Supply Rs.	Total Rs.
Factory	1,235	27,055	1,911	11,425	1,166	26,147	—	68,939
Chemical Laboratory and Administration Block	267	21,273	1,839	2,669	6,068	188	1,341	33,645
Botanical Laboratory	387	14,497	1,910	1,140	1,358	—	641	19,933
Battery House	—	1,156	—	—	—	5,772	—	6,928
Estate Office... ..	103	2,377	341	372	79	—	—	3,272
Director's Bungalow	464	16,288	2,596	1,173	434	—	—	20,955
Senior Staff Bungalows, 1-5	2,564	62,726	11,686	3,463	6,944	—	—	87,383
Estate Superintendent's Bungalow	243	9,064	1,773	652	1,376	—	—	13,108
Secretary's Bungalow	183	7,982	575	407	1,237	—	—	10,384
Chief Clerk's Bungalow	79	4,522	95	—	455	—	—	5,141
10 Junior Staff Bungalows... ..	1,302	38,120	670	—	2,982	—	—	43,074
Water and Power Scheme— Dartonfield	—	—	—	—	—	—	—	10,908
Nivitigalakele	—	—	—	—	—	—	—	2,756
	6,827	205,060	23,396	21,301	22,089	32,107	1,982	326,426

REPORT OF THE CHEMIST FOR 1938.

From the 13th April to the 14th November, 1938, the Chemist, Mr. M. W. Philpott, was away from Ceylon on leave. During this period chemical investigations were supervised by the Director.

As before, the work of the Department will be described under three headings: (1) Manufacture of vulcanised products, (2) Latex subjects, (3) Miscellaneous.

MANUFACTURE OF VULCANISED PRODUCTS

The experimental production of vulcanised articles at Dartonfield was started in 1935 in order to illustrate the feasibility of manufacturing in Ceylon and to demonstrate the methods and type of machinery commonly employed. At the beginning of 1938 the Research Board decided that the original intention had been adequately carried out and that in view of the lack of interest on the part of potential local industrialists the work should cease at the end of 1938. During the year under review, therefore, the Department continued to execute small orders for rubber tubing, erasers, table mats, tyre repair compounds, moulded articles, flooring, etc., but did not undertake the production of any new classes of goods.

In accordance with the Board's decision to provide facilities for training a student in Rubber Technology, Mr. C. D. Dias who was nominated by the Minister for Labour, Industry and Commerce was given a short course of instruction between 3rd January, 1938, and 31st July, 1938. Mr. Dias occupied himself during his stay at Dartonfield with the study of rubber technology from the practical and theoretical standpoints and at the end of his term he submitted a creditable report on his work.

Now that this branch of the Research Scheme's work has been discontinued the Chemical Department will be able to give closer attention to problems which are of more direct importance to the rubber producer.

The position regarding the local manufacture of rubber products and the demonstrations given at Dartonfield was reviewed in the Research Scheme's 2nd Quarterly Circular for 1938, pages 63-70.

LATEX SUBJECTS

Latex Shipment.—The total world production of rubber in the form of latex amounted in 1937 to over 35,500 tons of which Ceylon contributed only four tons. In view of the growth in the demand for liquid latex which has taken place in the last decade it is difficult to account for the fact that Ceylon estates have not yet shown any serious interest in this form of production. For the past three years small consignments of normal preserved latex have been prepared and despatched from Dartonfield to demonstrate the

feasibility of this type of manufacture and to illustrate the recommended method of working.

Now that the main patents controlling the manufacture of concentrated latex have expired in Ceylon, it is hoped that some of the larger groups of estates may reconsider the question of marketing latex grades.

Latex Concentration.—The concentration of latex by creaming and by centrifuging ceased during 1938 to be controlled in Ceylon by patents. Steps were therefore taken to study the known processes of concentration on a commercial scale in order to acquire information on costs and procedure.

(a) *Concentration by Creaming.*—Evidence of a growing interest in the utilisation of latex in the East was shown by the number of enquiries for concentrated latex that were received from India during the year. Several shipments of creamed latex were made from Dartonfield to buyers in India.

There was little opportunity during the year of conducting any fresh investigations on the creaming of latex with chemical creaming agents. A few trials were made, however, to discover the effect of ageing on the efficiency of creaming. It is well-known that freshly preserved latex does not cream so readily as latex which has been stored for some time, but it was thought desirable to determine the minimum period necessary to secure satisfactory separation. The conclusion reached was that with latex preserved with 0.7 per cent. of ammonia a period of at least four days should be allowed to elapse between collection and creaming.

Experiments designed to illustrate the effect which the shape of the creaming vessel has on the efficiency of creaming gave some interesting results. Although it is generally recognised that the dimensions of the tank have a bearing on the rate and extent of creaming there is no published information available to indicate the principles on which creaming plant should be designed. The experiments referred to were carried out in laboratory sized vessels and arrangements are now being made to repeat the trials on a larger scale.

(b) *Concentration by Centrifugation.*—Trials were started early in the year with a latex separator of British manufacture. It was found that while this machine was capable of yielding 60 per cent. concentrates, its efficiency (ratio of dry rubber in the concentrate to dry rubber in the feed) was relatively poor. Under the most favourable conditions of working the throughput was about 35 gallons per hour, the efficiency about 75 per cent. and the D.R.C. of the cream and skim 61 and 15 per cent. respectively.

During the first few days after ammoniation a progressive change takes place in latex which, for a given setting of the machine, results in a progressive improvement in efficiency of separation. It was found, however, that by suitable adjustments of the setting, satisfactory concentration could be achieved by centrifuging on the day after ammoniation. The trials indicated that for efficient working the rate of feed and the position of the skim screws must be specially adjusted to suit the condition of the latex.

Considered apart from its performance the machine could not be regarded as entirely satisfactory on account of the materials used in its construction. Some of the parts of the bowl were made of tinned brass from which the tinning tended to wear away with use. Although no serious copper contamination was detected it is clear that the machine could not be recommended for general use unless it were constructed of materials not open to this objection.

The comparatively high rubber content of the skim latex made it necessary to give close attention to the recovery of rubber from the skim latex.

The coagulation of alkaline latex presents difficulties which are not encountered in the case of ordinary field latex. Five methods of effecting the recovery of the rubber were compared, viz. (1) Coagulation with acid and subsequent manufacture into crepe, (2) Coagulation with magnesium salts and sodium silicofluoride (see *Journal of the Rubber Research Institute of Malaya*, 1934, 5, 351), (3) Coagulation by fermentation, (4) Recentrifuging, and (5) Creaming.

(1) It was found that for the complete precipitation of rubber from the skim latex the quantity of formic acid required was about ten times the quantity normally used for the coagulation of field latex. This proportion of coagulant could probably be reduced if the latex were first de-ammoniated but it is doubtful whether the saving thus effected would be as great as the cost of de-ammoniating. The rubber produced had a light brown colour and commands at the present time about the same price as smoked sheet.

(2) Mixtures of magnesium sulphate or chloride with sodium silicofluoride readily produce coagula suitable for crepe manufacture and have also been suggested for converting alkaline latex into smoked sheet. For a given quantity of rubber the cost of the coagulant is somewhat less than the cost of formic acid.

(3) Complete coagulation occurs spontaneously if the latex is mixed with a small quantity of sugar. In one trial ammonia was removed from the skim by air blowing and cane sugar was added in the proportion of one part to 45 parts of dry rubber. Six days later the latex was completely coagulated leaving a clear yellow serum. This method has the objection that the coagulation is slow and is associated with a strong putrefactive odour.

(4) Skim latex can be readily re-centrifuged in the separator to yield a substantial return of rubber in the form of cream of 50-55 per cent. concentration. The character of such secondary concentrates differs from the primary concentrate in possessing an abnormally high proportion of the smallest rubber globules. Consideration is being given to the possibility of utilising secondary concentrates for purposes in which a small particle size is an advantage.

(5) The rubber content of the skim can be increased by creaming to 35-40 per cent. Here again the product is abnormal by virtue of the small particle size which results from the preferential accumulation of the larger particles in the primary concentrate.

Latex Storage.—Data on the changes in D.R.C. and ammonia content which occur during the storage of preserved latex were collected during the year by examining at six monthly intervals four batches of normal and creamed latex prepared in November, 1937. The following table summarises the results obtained after one year's tropical storage:—

				Dry Rubber Content		Ammonia Content (%)	
				Nov., 1937	Dec., 1938	Nov., 1937	Dec., 1938
<i>Field Latex</i>							
Tin No. 3 (full)	...	...	...	39.4	39.3	0.48	0.46
Tin No. 4 ($\frac{1}{2}$ full)	...	...	...	39.9	38.5	0.48	0.46
Glass bottle No. 4B	...	...	...	39.3	38.9	0.48	0.46
<i>Field Latex</i>							
Tin No. 7 (full)	...	...	...	39.8	39.4	0.80	0.78
Tin No. 8 ($\frac{1}{2}$ full)	...	...	...	41.0	39.9	0.77	0.75
Glass bottle No. 8B	...	...	...	36.9	36.5	0.84	0.81
<i>Creamed Latex</i>							
Tin No. 11 (full)	...	...	...	49.0	52.8	0.42	0.37
Tin No. 12 ($\frac{1}{2}$ full)	...	...	...	52.2	51.9	0.40	0.37
Glass bottle No. 12B	...	...	...	52.7	52.5	0.43	0.36
<i>Creamed Latex</i>							
Tin No. 15 (full)	...	...	...	59.3	57.0	0.45	0.43
Tin No. 16 ($\frac{1}{2}$ full)	...	...	...	59.9	55.0	0.50	0.40
Glass bottle No. 16A	...	...	...	56.8	56.6	0.48	0.43

It will be observed that the alterations in ammonia content were, from a practical standpoint, negligible. The dry rubber contents, on the other hand, show in some cases a substantial decrease. The inconsistencies in the figures for creamed latex are due to the unsatisfactory method of sampling which was adopted. Further attention is being given to the problem of sampling aged concentrated latex.

Deterioration in colour was most strongly marked in the case of samples which had been stored in half-full tins. The field latex in full tins was also discoloured but the creamed latices had retained their original whiteness with only a slight greying. The samples stored in glass bottles were almost as white as when freshly prepared.

The results of parallel tests made on the same set of latices kept for one year in London have not yet been received but the figures obtained in London after six months storage showed almost no change in rubber or ammonia content but a substantial decrease in stability. Stability measurements were not made in Ceylon.

MISCELLANEOUS SUBJECTS

Purified Rubber.—Evidence of a growing interest in the commercial production of purified rubber is afforded by the number of patents and additions to the literature which have been published during the year. Purified rubber is chiefly required by cable manufacturers on account of its reduced tendency to absorb moisture, but its utilisation would doubtless be extended if it could be produced at a lower cost than at present.

It is intended during 1939 to make a study of available methods of purification and to develop, if possible, a process which could be recommended for Ceylon estates. Towards the end of the year under review some preliminary trials were made to determine the degree of purification achieved by (1) fractional coagulation, (2) extraction of coagulum with dilute saline solutions, (3) treatment of latex with absorptive materials, (4) digestion of latex with alkali, (5) multiple concentration. The aim of the investigation is to select a suitable treatment or series of treatments which will yield, with the least possible modification of normal estate practice, a product sufficiently free from nitrogenous and other non-rubber substances to be classed with the purified rubbers already available. The work was not sufficiently far advanced at the close of the year to warrant a report on the results obtained up to date.

Variability of Raw Rubber.—The study of variability will occupy an important place in the Chemical Department's programme of work for 1939. A renewed attack on this problem of long standing has now been made possible by (1) the co-operation of manufacturers in arriving at an agreed definition of their requirements, and (2) the general acceptance among the major users of rubber of a standard test mixing for estimating the extent of variation.

As a preliminary to the study of factors which are responsible for variability it was decided early in the year to make monthly vulcanisation tests on rubber obtained from the four divisions of Dartonfield. The data so collected would have formed a useful basis for the more extensive survey planned for 1939; but unfortunately the date of starting these tests had to be postponed until November owing to a failure of the new autoclave press. The regular examination of rubber from Dartonfield will be continued during 1939 and samples will also be obtained from local estates which are believed to produce abnormal rubber. In cases where it is found that the variability arises from methods of processing and is therefore controllable, suggestions will be made for eliminating the abnormality of the product.

Nitrite Crumb Rubber.—Road surfacing trials with bituminous asphalt containing a proportion of nitrite crumb rubber have been continued and extended in England during the year. Experiments of this kind must necessarily be slow since the normal life of the type of road surface which is being used in these tests is 7 or 8 years. When the writer inspected the trial areas at Poole, Dorset, in August, the road had been laid for only 14 months and it was difficult to form a definite opinion on the value of small additions of rubber to the road

compound. On the whole the evidence indicates that if the rubber is suitably incorporated it improves the non-skid properties of the surfacing compound.

The only experimental work on the subject of nitrite crumb production which was undertaken at Dartonfield during the year was in connection with the tendency of the crumb to mass in storage. The present measure adopted to prevent the particles of crumb from cohering is to dust with 3 per cent. of zinc stearate, but this does not wholly eliminate the trouble. A number of alternative dusting powders (china clay, french chalk, silica, kieselguhr, light magnesium carbonate, etc.), were tried, but they were all less effective than zinc stearate. At the time of writing no satisfactory method had been found to keep the rubber in a free-flowing condition.

Chlorinated Rubber.—The method suggested by the Staff of the London Advisory Committee for obtaining chlorinated derivatives from latex was investigated with both fresh and ammonia preserved latex.

Some difficulty was experienced at first in controlling the rate of coagulation of the latex on the addition of the chlorinating reagents and it was found convenient to work with filterable rubber flocculates. Such flocculates were produced when the reagents were added to dilute (16 per cent.) latex containing a small amount of a protective agent such as casein; the sera from creaming vessels and from coagulating tanks were also found to have the required protective action. Alternatively centrifuge skim latex could be used without the addition of any protective material. In those trials where ammoniated latex or cream serum was used the ammonia was first neutralised with formalin.

In these experiments, as in those which were carried out by the Staff of the London Advisory Committee a considerable excess of reagents was required for the formation of a material of a given chlorine content. The following table shows the results of some typical trials. The term "available chlorine" means the amount of free chlorine which is produced by the reagents, expressed as a percentage of the quantity of rubber in the latex.

No. of Experiment		Available Chlorine per cent.		Combined Chlorine in product per cent.
C.5	...	50	...	1.1
C.18	...	70	...	6.3
C.6	...	100	...	8.5
C.20	...	100	...	8.7
C.10	...	120	...	37.8
C.17	...	125	...	19.2
C.7	...	150	...	20.3
C.4	...	200	...	37.7
C.13	...	200	...	42.5
C.16	...	200	...	40.1
C.9	...	300	...	40.5

In all the above trials except C.10 the chlorination was done on flocculated latex. In C.10 the chlorinating agents were added to the disintegrated spongy coagulum which is obtained in the manufacture of nitrite crumb. It will be noted that in this case a particularly high proportion of the available chlorine combined with the rubber.

While all the products containing less than 10 per cent. of chlorine were capable of being creped on the mill, those containing between 6 and 10 per cent. had a tendency to crumble. The products C.4, C.9, C.10, C.13 and C.16, all of which had chlorine contents of over 35 per cent. were obtained as fine white powders which did not discolour when dried in air. Samples of C.7 and C.17 (20 per cent. of chlorine) turned very dark on drying.

When examined a few weeks after preparation none of these derivatives was free from the smell which accompanies the oxidation of rubber.

The products were not appreciably soluble in the usual solvents for chlorinated rubber, but it is understood that further work in London has shown that by suitably selecting the conditions of the reaction a high degree of solubility can be obtained.

Estate Manufacture.—The estate crop was mainly prepared in the form of crepe and smoked sheet. No changes were made in the details of crepe manufacture but a new sheeting machine of a type which has been well reported on in Malaya was installed by the local agents for trial and demonstration. Trials with the machine were still in progress at the end of the year.

In addition to the ordinary standard grades $1\frac{1}{2}$ tons of nitrite crumb and $1\frac{3}{4}$ tons (dry rubber) of preserved latex were shipped to London or India.

Smallholders' Coagulants.—An enquiry which was started by the Smallholdings Propaganda Officer on the nature and cost of coagulants used by smallholders was delayed on account of the writer's absence on leave. As a preliminary to the main investigation, however, twenty-four samples of coagulant were purchased (12 during the year under review and 12 in 1937) by Smallholdings Instructors from small retailers and submitted to the Chemical Department to be tested for strength and contaminating substances. A note on the samples tested during 1938 will be found in the Report of the Smallholdings Propaganda Officer. The following is a summary of the results:—

Number of coagulants examined	...	...	...	...	...	24
Number described as acetic acid	...	...	...	...	...	13
Number described as formic acid	...	...	...	...	...	11
Number of unsatisfactory quality	...	...	...	...	...	3
Number of abnormally high price	...	...	...	...	...	3

Of the three unsatisfactory samples one was acetic acid contaminated with kerosene, another was a fair sample of acetic acid which was described and sold as formic acid and the third was acetic acid which was both contaminated with kerosene and sold as formic acid.

The set of samples examined is not necessarily representative of the coagulants which are used by smallholders in Ceylon and further comment must be reserved until a more complete survey has been made.

Meteorological Observations.—At the request of the Superintendent, Colombo Observatory, arrangements were made to forward from June 1st onwards a daily telegraphic summary of weather observations for inclusion in the weather report issued by the Observatory. The summary of weather records for 1938 is as follows :—

	1938	1937
	Ins.	Ins.
Rainfall	151·85	180·52
Highest monthly rainfall	25·52 (April)	36·34 (May)
Highest daily rainfall	4·61 (April 6th)	4·93 (April 3rd)
Highest shade temperature (day)	92·2° (Feb. 24th & Mar. 30th)	95·0° (Feb. 16th)
Lowest temperature (night)	65·8° (Jan. 8th)	57·5° (Dec. 8th)
Number of rainy days	249	219

Enquiries and Correspondence.—Enquiries were dealt with on the following chemical subjects :—

Latex	20
Preserved Latex	18
Factory Procedure and Equipment	46
Drying House Design	11
Defects in Raw Rubber	5
Alternative forms of Raw Rubber	16
Uses for Rubber	4
Vulcanised Products	66
Miscellaneous	31

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Publications.—The following article was published in the 2nd Quarterly Circular for 1938 :—

“ The Experimental Manufacture of Vulcanised Products at Dartonfield.”

(Sgd.) M. W. PHILPOTT,
Chemist.

Research Laboratories,
Agalawatta,

4th February, 1939.

REPORT OF THE BOTANIST AND MYCOLOGIST FOR 1938.

This report covers all work on pathological, botanical and soils problems during 1938. With the appointment of Dr. L. A. Whelan as Soil Chemist towards the end of the year a separate Division has been constituted, and this is the last year in which work of this nature will be recorded by the writer.

STAFF AND ORGANISATION

With the appointment of Dr. C. E. Ford as Geneticist in May, and of Dr. L. A. Whelan as Soil Chemist in November, the staff on the agricultural side of the Scheme's activities has been brought up to full strength. These additions will make it possible to re-orientate the research and advisory programmes of individual officers. Thus, Mr. Murray will be relieved of much detailed work in connection with the study of clones and of most of the research and advisory work in connection with soils problems, and will be able to devote more time to pathological and other aspects of botanical research. The subject of soil management in relation to the nutrition and health of the tree is one in which close collaboration between the Botanist and the Soil Chemist is essential, and certain aspects of the subject will remain within the province of the Botanical Division.

For the present Mr. de Silva is continuing his general supervision of all field experiments at Dartonfield and certain trials at Nivitigalakele, and the transference of responsibility for the relevant portions of this work to the Soil Chemist has been held in abeyance. It may be more satisfactory for Mr. de Silva to continue with this work permanently.

The assumption of full responsibility by officers new to the country and to the crop must necessarily be a slow and gradual process, and the increase in staff has not yet had much effect either in extending the scope of research or in relieving the other officers of routine and advisory work. There is no doubt, however, that the benefits will be felt in 1939.

PATHOLOGICAL WORK Oidium Leaf Disease

The period of refoliation during the months of February and March was characterised by unusually cool, dull, wet weather in most districts. It is now well established that such conditions are not only favourable to the activities of Oidium but also delay the maturation of the young leaves, and the inevitable consequence was an exceptionally severe incidence of the disease. It is probably true to say, in fact, that on most low-country estates the trees were defoliated to a greater extent than in any previous year. The writer's observation during this period were mainly confined to the Kalutara District, but reports received from estates elsewhere, and observations made in later months, confirm the general applicability of these remarks.

Sulphur dusting programmes were carried out on most estates at mid-country elevations and on many estates in the low-country districts, but the

degree of control obtained was mostly very poor. The reasons are not far to seek: not only was the extent of infection unusually high, but the wet weather seriously interfered with operations. Sulphur applied in the morning was often largely washed from the leaves by a heavy shower in the afternoon and, moreover, the fungicidal efficiency of such sulphur as remained on the leaves was probably impaired by the absence of sun.

This experience has naturally been discouraging to proprietors of mid-country estates who have relied on sulphur dusting as a means of controlling their most serious affliction, and there has been considerable agitation for further research with a view to discovering a more efficient form of treatment. Although it may be possible to improve existing methods it is most unlikely that a more efficacious fungicide than sulphur could be employed at anything like a comparable price, and the development of an alternative method of *direct* control is not considered to offer promising possibilities. The occurrence of a more normal season in 1939 would go far to reassuring mid-country planters of the benefits of sulphur dusting over a period of years.

The directions in which research might prove profitable are indicated below, and proposals for work on these lines have been approved by the Board.

(1) **Development by Selection and/or Breeding of Resistant Clones.**—A preliminary investigation carried out in 1929 did not reveal the existence of any useful degree of resistance to the disease, but it is proposed to extend observations with Estate Superintendents in the Matale District.

(2) **Trials of Dusting Sulphurs.**—Arrangements have been made for field trials of four brands of dusting sulphur to be conducted on two estates, one in Matale and the other in Kurunegala.

(3) **Adhesives.**—The possibilities of increasing the adherence of sulphur to the leaves in wet weather by the admixture of such substances as flour, milk powder, blood albumen, etc., will be investigated.

Root Disease

Attention was drawn in the Annual Report for 1937 to the numerous outbreaks of root disease in replanted clearings in areas where there was no previous history of disease in the former stand. It is now a matter of general experience that the apparent freedom of the old trees from root fungi is no guarantee that the young plants will not be attacked, and there is at present no means of determining in advance what the incidence of these fungi may be. Thus, of two clearings in the same neighbourhood one may be entirely free of *Fomes lignosus*, whereas in the other the fungus may be almost ubiquitous; yet in both areas the old trees may have appeared to be quite healthy. In the former case the preliminary removal of lateral roots would be waste of money, whereas in the latter any reasonable expenditure which would help to eradicate the centres of infection or locate their presence would be amply justified. It is the unpredictability of the incidence of these fungi which makes the problem so perplexing.

As a preliminary step in the closer study of this subject, a questionnaire was circulated to all estates on our publications list in order to determine the present position on estates undertaking replanting operations. The figures given in the following tables show the number of plants lost from root disease up to August, 1938. Only areas which were thought to be free of root disease fungi, as judged by the condition of the former stand, are included :—

No. of estates to which questionnaire was sent...	...	...	609
No. of replies received	...	...	274
No. of estates with replanted clearings	...	...	156
No. of estates without replanted clearings	...	...	118
			274

Table I summarises the figures received from all estates. Columns 1 and 2 give the extent of the areas for the various years of replanting covered by the replies. The official figures issued by the Rubber Controller for the period of control are given in brackets, and these show that the replies may be taken as fairly representative of the whole. (Where the figure covered by the questionnaire exceeds the official figure, *e.g.* in 1937, the apparent discrepancy is doubtless due to one or more areas having been cleared in 1937, but not planted till 1938).

In totalling the figures in each column the year 1938 has been excluded as these clearings could only have been planted shortly before the questionnaire was circulated, and there would have been no time for root disease to develop.

This general survey shows the percentage losses for all clearings (except 1938) to be about .1 per cent. Although, of course, these figures are not final they appear to indicate that there is, in general, no cause for serious apprehension. In certain individual clearings, however, the number of casualties have assumed formidable proportions. On 17 estates, representing 1,713 acres, there has been a loss of more than one plant for every five acres, and these estates account for 976 out of the total of 1,245 fatal infections. 498 cases of *Fomes lignosus* are recorded from one estate alone. An analysis by districts shows that most of the severely affected areas are in Kalutara.

One of the questions asked was whether the lateral roots were removed prior to replanting, and the replies have been separately analysed according as to whether a positive or negative reply was received. The outcome of this analysis is given in Table II, the figures in italics representing areas from which the roots were removed and those in Roman type the areas from which they were not removed. The thoroughness with which the removal was carried out will, of course, have varied on different estates, but the work was mostly confined to the removal of the larger laterals. It is assumed that the tap roots were taken out in all cases as this is the almost universal practice.

Replies received from the drier districts such as Matale, Kurunegala and Uva have been excluded from Table II as the questionnaire shows that the incidence of root disease in these localities is negligible. Estates which gave no, or an indecisive, reply to this question have also been omitted.

TABLE I.
Root Disease Questionnaire—August, 1938.

Year of Replanting	Acres (Rubber Controller's Figures in Brackets)	Number of Rubber Plants Killed by			All Fungi
		<i>Fomes lignosus</i>	<i>Fomes noxius</i>	<i>Poria hypobrunnea</i>	
Prior to 1930 ...	77	—	—	—	—
1930 ...	54	2	—	—	2
1931 ...	133	38	—	—	38
1932 ...	235	13	—	—	13
1933 ...	137	4	—	—	4
1934 ...	293 (291)	9	2	—	11
1935 ...	427 (761)	35	9	3	47
1936 ...	2,505 (4,379)	718	30	31	779
1937 ...	6,187 (6,162)	301	33	17	351
1938 ...	4,873	7	1	—	8
Total (excluding 1938) ...	10,048 (11,593)	1,120	74	51	1,245

Root Disease Questionnaire—August, 1938.

Year of Replanting		Acres	Number of Rubber Plants Killed by				All Fungi
			<i>Fomes lignosus</i>	<i>Fomes noxius</i>	<i>Poria hypobrunnea</i>		
Prior to 1930	...	60	7	—	—	—	—
1930	...	18	25	—	—	—	2
1931	...	—	38	—	—	—	35
1932	...	57	150	—	—	—	5
1933	...	15	111	—	—	—	4
1934	...	50	188	—	—	—	9
1935	...	139	155	27	—	—	7
1936	...	771	1,583	37	9	2	48
1937	...	1,355	3,502	100	1	7	108
Total	...	2,465	5,659	164	10	9	183
							951

N.B.—Figures in italics refer to areas from which the larger lateral roots were removed.

Figures in Roman type refer to areas from which the larger lateral roots were not removed.

If the average number of trees per acre be taken as 120, the percentage loss is about .06 per cent. in the areas from which the roots were removed and .14 per cent. in the areas from which they were not removed. This seems to indicate that the root removal has been responsible for a reduction in the incidence of disease amongst the young plants, and is partially effective as a precautionary measure.

The replies to other questions have elicited the facts that the affected plants usually occur singly, that the source of infection can almost always be traced to an old Rubber root, and that the control measures adopted, consisting mainly of digging over the infected areas and removing all roots, have so far usually been effective.

As these figures are only of an interim nature no attempt will be made at this stage to draw conclusions, but it is proposed to issue further questionnaires on the subject at annual intervals. Attention has already been drawn to the large variation in root disease incidence between areas which are in the same neighbourhood or even on the same estate. The problem of precautionary measures is clearly a local one, but it is difficult to know by what criterion to be guided. Perhaps the wisest course at the present juncture is to recommend the removal of all the larger lateral roots when replanting land in localities in which *Fomes lignosus* is known to have caused widespread damage. Such work can be carried out for about Rs. 10 per acre. Subsequent measures must be dependent on the amount of disease which develops.

During the course of the year the writer visited a number of estates to advise on the treatment of root disease in replanted areas. On several occasions the method of periodical inspection of the roots of each individual tree, which was evolved by the Rubber Research Institute of Malaya, was advocated, and on one estate an experiment to determine the value of this treatment under local conditions was laid down.

Minor Diseases and Pests

(1) **Bird's Eye Spot (*Helminthosporium Heveae*).**—This disease continues to give trouble in nurseries and no satisfactory method of control has yet been devised. An experiment with the undermentioned spray fluids was carried out on nine months old seedlings in a nursery at Nivitigalakele, but the results were almost entirely negative, only sulphur powder exercising any appreciable control:—

Cosmic Copper	...	...	...	...	1 in 400	} Actin as spreader
Copper Cosmol	...	...	...	...	1 in 150	
Grofrogren "A"	...	...	...	...	1 in 400	
Bouisol	...	...	...	...	1 in 80	
Sulfluid	...	...	...	...	1 in 160	
Sulphur Powder						

The failure of the liquid sprays is thought to be mainly due to the physical difficulty of maintaining a fungicidal covering on the surface of the rapidly

growing leaves. Also in the experiment in question, as is usually the case on estates, the plants were heavily infected before the first application was made, and it is possible that positive results might have been obtained had the treatment been undertaken at the first symptoms of the disease. It would appear that weekly rounds of sulphur dusting will do something towards mitigating the damage, and any fertiliser treatment which forces the plant through its early stages of growth is also helpful.

The suggestion has been made that a light shading of the nurseries would assist the seedlings to resist infection, and this matter will receive attention.

(2) **Cockchafer Grubs.**—Numerous reports of damage by the grub of the cockchafer beetle *Leucopholis* (*Lepidiota*) *punguis* to the roots of young seedlings and recently transplanted stumps have been received, and although this insect can hardly be said to have attained the status of a major pest it is causing considerable concern on some estates. The pressure of other work has prevented any field investigations being undertaken, but suggestions for control by the use of carbon bisulphide as a soil fumigant have been made to a number of estates, and from reports received this seems to be an effective though expensive measure. No attacks have been recorded on older trees or on cover plants such as are attributed in Malaya to the related species *Psilopholis vestita*.

BOTANICAL WORK

The Improvement of Planting Material

A. Budgrafting.

1. Selection of Mother Trees

Provision has been made for the planting of test plots of about 40 new clones in 1939. These will mostly be established from high-yielding mother trees derived from Tjikadoe seed, and Dr. Ford has studied the yield records and other characteristics of several hundred such trees planted at Nivitigalakele, Wagolla and on two estates. The final selection will be made in March, 1939.

2. Budding, Planting and Attention

No work has been done on the technique of the budding operation except to test the rubber budding tape manufactured at Dartonfield. This has proved very satisfactory in use both in the field and in the nursery. It has the advantage of being usable several times.

An experiment was commenced at the end of the year to compare various forms of treatment in connection with the transplanting of budded stumps. These include the use of Hortomone "A," a proprietary preparation for the stimulation of root growth. No results are available at the time of writing this report.

3. Stock-Scion Relationship

(1) In 1927 an experiment was commenced at Nivitigalakele to investigate the possible effect of the stock on the growth and yield of the scion. The method

of approach was to establish marcots from a number of stocks of the original buddings. When the bud had taken the stock, instead of being cut off and thrown away, was marcotted and subsequently planted. In this way a number of pairs was established, one member of each of which consists of the marcot, representing the stock growing on its own root system, and the other the scion growing on the stock root system. In other words, the marcot represents what the stock would have been had it been allowed to grow unbudded.

An examination was made of the yields in the years 1935, 1936 and 1937 of 31 pairs, and of the girth measurements in June, 1938, of 35 pairs. Any influence which the stock may have exerted on the scion would be reflected in a correlation between the members of a pair in respect of yield or girth. The values of the various correlation co-efficients are given in Table III, together with the heights of the tapping cut on the buddings at the end of each tapping year.

TABLE III
Correlation Co-efficients, Marcot-Budding Pairs

Year	Co-efficient of Correlation for			Height of cut on Buddings at end of Year
	Girth	Yield	Yield per Inch of Cut	
1935 ...	—	+·1584	+·2004	15½ ins.
1936 ...	—	+·2889	+·5059	10 „
1937 ...	—	+·4639	+·6473	4½ „
1938 ...	+·1926	—	—	—

N.B.—The figures in italics denote significant values.

The correlation for girth is positive, but so low as to be of doubtful significance. This would suggest that the potential vigour of the stock is of little importance, but in actual fact the correlation may have been masked owing to the lack of uniformity of the particular piece of land on which the marcots were planted.

Attention is particularly directed to the figures in the fourth column where the correlation is given for the yield per inch of cut. The figures have been calculated on this basis in order to “iron out” the ineluctable variation due to position. It will be noted that the correlation increases as the tapping cut approaches the union, the values for 1936 and 1937 being fully significant and fairly high.

It is clear that the potential yield of the stock exerts an increasing effect on the yield of the scion as the tapping cut approaches stock tissues. This is to be expected since when the cut is close to the union the latex must be drawn from a zone which includes the junction and the upper part of the stock. The figures suggest that it is only when the cut is within about 15 inches of the union that the stock effect is important.

The data refer to buddings of six clones. If only one clone had been used the correlation co-efficients would probably have had higher values, though it is possible that some clones are more susceptible to stock influence than others.

(2) In October, 1930, an experiment was laid down on the Iriyagama Division of the Experiment Station, Peradeniya, to compare the growth and yield of a number of local clones budded (*a*) on to stocks derived from illegitimate seed from the respective mother trees, and (*b*) on to mixed stocks. Ten clones were used and planted in five replicated blocks of 12 trees each. Each plot was sub-divided into two for the comparison (*a*) *vs.* (*b*). Early growth measurements showed no better development when the buddings were made on their "own" stocks than when they were made on to mixed stocks, presumably unrelated. Table IV gives the measurements of girth made in February, 1938, each figure being the mean for 30 trees.

TABLE IV

Clones	Girth in inches on	
	"Own" Stocks	Mixed Stocks
H. 2	16.1	16.3
H. 445	18.3	17.7
H. 440	14.6	14.5
H. 82	18.0	19.2
H. 75	16.7	16.0
P. 5	18.1	18.3
P. 12	17.1	17.6
H. 400	14.7	15.3
H. 26	18.5	17.0
H. 140	15.4	17.2
Mean	16.75	16.91

It is clear that as far as growth is concerned there is, in general, neither advantage nor disadvantage in using illegitimate seedlings of the same clone as stocks. Where there is an appreciable difference between "own stocks" and "mixed stocks," this is probably due to the fact that the seedlings from that particular mother-tree are either more or less vigorous than the average. It is possible that the junction of related tissues may be found to carry an advantage when the trees are tapped in the vicinity of the union.

We are indebted to the Director of Agriculture for permission to publish these figures.

4. Studies on Clones

(a) *Ceylon Clones.*—Test-tapping of Ceylon clones has been continued at Nivitigalakele, Wagolla and on various estates co-operating with the Scheme, the work having been under the charge of Dr. Ford for the latter half of the year.

A total of 104 clones were tapped at Nivitigalakele during the year. As none of the clones in the 1926 and 1927 clearings is of outstanding promise, the test tapping of individual trees in these areas was discontinued except for marcots and Tjikadoe seedlings and certain experimental buddings. The latex from each clone is, however, collected and measured separately, and the yield of rubber calculated from a determination of the dry rubber content.

Some of the clones in the 1928 clearings are giving excellent promise. The highest yield during the year was given by clone Wagga 6278—13.1 lb. per tree for 124 tappings at eight years old (third year of tapping). The results for 1937 of the more interesting clones were published in Quarterly Circular, Vol. 15, Part 2, and the figures for 1938 will be similarly published in 1939.

(b) *Imported Clones.*—Records of the test tapping of imported clones are regularly received from a number of estates in different districts, as well as from the Iriyagama Division of the Experiment Station and the Practical Farm School, Wagolla. The figures are published in the Quarterly Circular at annual intervals. The reduction in the export quota discouraged estates from commencing the tapping of budded areas on a commercial scale, with the result that very few figures of this nature are available.

5. *Distribution of Material*

Arrangements for the sale of budwood and budded stumps were transferred to the Estate Superintendent and the relevant figures are given in his report.

6. *Importation of Budwood*

As a consequence of the unsatisfactory results obtained with shipments of budwood of the Pilmoor clones from Malaya to Ceylon in 1937, the Rubber Research Institute of Malaya solicited our co-operation in an investigation to shed light on the causes of the comparative failure. An experimental consignment of Clones B. 84 and D. 65 was received from Malaya, the budwood of each clone having been taken from three different sources. The outstanding conclusion was that for shipment involving storage for seven days or more the budwood should be considerably more mature than for local use. This was particularly marked in the case of Clone B. 84, the nursery budwood of which gave an average of only 1.4 successes per yard, whereas wood cut from field trees, although rather tough, gave 10.2 successes per yard. The corresponding figures for D. 65 were 9.0 and 16.7 respectively. The method of packing in moist coir fibre was satisfactory except that in one case, which had been kept in cold storage on the ship, the contents were too damp, resulting in advanced degeneration of the wood.

B. *Selection and Breeding*

A provisional breeding programme for the flowering season of 1939 has been drawn up by Dr. Ford. This provides for artificial cross-fertilization between high-yielding Ceylon clones and imported clones which are known to be of value as seed parents.

Problems Connected with Mature Areas

A. Tapping

(1) *Mature Seedling Trees*.—The first year of the experiment to compare a number of different tapping systems in the mature Rubber on Dartonfield was completed in February, 1938, and the results are summarised in Table V.

Yield.—In order to compensate for the initial plot variation the yields have been adjusted by means of a regression on the results of the uniformity trial of 1936/37. In most cases the ratio between the various systems is much as expected. The double-three system without rest has, of course, given the highest yield, but there are indications of a decrease towards the end of the year. The difference between double-four and half spiral alternate day is not statistically significant. The relatively high yield from system No. 3 is interesting. This consists of tapping the tree on a half spiral cut on alternate days, but on alternating sides so that each cut is tapped once in four days. Further discussion of the relative yields would be premature as some of the systems have not yet completed a full cycle.

Bark Renewal.—It will be seen that 0.2 mm. covers the full range of treatment means. None of the differences is significant and the rate of renewal for all treatments may be regarded as very satisfactory. It is possible that with trees in a poorer agricultural condition a response to tapping treatment might be shown, but it would appear that under conditions favourable for renewal the rate of regeneration, at any rate in the first year, is almost equally good with any reasonable system of tapping.

TABLE V
Tapping Experiment

Tapping System	Adjusted Yield 1937-38		Percentage Scrap (cut and tree only)	Bark Renewal 13(months)
	lbs.per plot 30 trees	Percentage of $\frac{1}{2}$ sp.a.d.		
<i>Two-Four Day Series—</i>				
1. $\frac{1}{2}$ sp.a.d.	180.4	100.0	9.0	5.7 mm.
2. $\frac{1}{2}$ sp.a.d. A.B.C. 12/6 ...	127.8	70.8	12.0	5.7 „
3. $\frac{1}{2}$ sp.a.d. alt. sides	199.1	110.4	9.4	5.8 „
4. $2 \times \frac{1}{4}$ sp.a.d.	153.3	85.0	11.2	5.8 „
5. D/4... ..	174.7	96.8	8.5	5.9 „
6. D/4 A.B.C. 12/6	132.0	73.2	7.8	5.8 „
<i>Three-Day Series—</i>				
7. $\frac{1}{2}$ sp. 3. d.	122.3	67.8	11.3	5.8 „
8. D/3... ..	202.6	112.3	9.3	5.7 „
9. D/3 A.B. 6/6	124.5	69.0	11.2	5.8 „
10. D/3 A.B.C. 12/6	136.8	75.8	10.5	5.8 „
11. D/3 A.B.C. 8/4	146.1	81.6	10.5	5.9 „
Significant Difference (P=.05)				
Within Series	17.2	9.5		Not signi- ficant
Between Series	18.9	10.5		

In the tapping experiment on Seventh Mile Estate the R.R.I. of Malaya has shown that with double-cut systems the rate of renewal above the cut is superior to that with single-cut systems, but that for renewals below the cut the reverse is the case. This is attributed to the interference to the downwards translocation of food substances imposed by the presence of a cut on either side of the tree. Detailed examination of the figures in the Dartonfield experiment reveals only a very slight indication of this effect, and it is concluded that under the conditions of the experiment the rate of renewal at the base of the tree is entirely satisfactory with double-cut as well as with single-cut systems.

A full report on the results for the first two years will be published in 1939.

(2) *Young Budded Trees*

Influence of Tapping on Growth.—It is a common assumption that the tapping of young trees retards the rate of girth increment, and in order to determine whether this idea could be substantiated the girth figures of a number of tapped and untapped budded trees at Nivitigalakele were examined. Buddings of eight clones made in the field in 1930 and taken into tapping in March, 1936, were compared with similar trees standing in the same plots which differ only in the fact that they were not tapped till March, 1938. The girth measurements were made at a height of 36 inches above the union; on the tapped trees the first panel was opened in March, 1936, at 18 inches from the union and a new panel on the opposite side in March, 1937, at 36 inches. The tapping system was half spiral on alternate days with a monthly consumption of half inch and a rest of about four weeks covering the period of refoliation.

The mean increase in girth of 74 tapped trees from March, 1936, to July, 1938, was 8.2 inches, while the corresponding figure for 55 untapped trees was 8.5 inches. This result lends little support to the contention that tapping, at least by normal methods, retards growth.

Rate of Bark Consumption.—An experiment was started at Nivitigalakele in April, 1938, to shed light on the optimum rate of bark consumption for maximum crop. The rates under comparison are $\frac{1}{2}$ inch, $\frac{3}{4}$ inch and 1 inch per month on normal half spiral alternate day tapping. Seven clones are used for the experiment, four trees of each clone being subjected to each treatment. After nine months' tapping the yields expressed as a percentage of the $\frac{1}{2}$ inch per month treatment were as follows:—

Consumption $\frac{1}{2}$ inch per month	...	...	...	...	100.0
" $\frac{3}{4}$ " "	...	...	...	...	98.1
" 1 " "	...	...	...	...	108.7

The treatment difference is not statistically significant, so that it would at present appear that there is little, if any, object in consuming more bark than the standard quantity of $\frac{1}{2}$ inch per month. During the period of nine months'

tapping—April–December—the trees were tapped on 110 occasions, so that the average thickness of shaving under the latter treatment was

$$\frac{4.5}{1.10} = 0.4 \text{ (1/25th) inch.}$$

It is difficult to know whether the results of a small-scale experiment of this nature are entirely applicable to commercial estate work as with the careful supervision necessary the tapping was of a particularly high standard. The more regular the thickness of shaving the thinner need it be to obtain the maximum flow.

Experiments on Estates.—Proposals have been formulated for a series of tapping experiments on estates with the object of determining the most suitable method of tapping budgrafts of the imported clones in most general use, but at the end of the year negotiations were still in progress.

B. Manuring.

1. *Mature Seedling Trees*

General.—The analysis of advisory correspondence given towards the end of this report shows that manuring was one of the main subjects of interest during the year. Enquiries were mostly with reference to the desirability of applying phosphate and potash, the best time of the year to manure and the most suitable method of application. The general trend of our present advice is to advocate the broadcasting of inorganic fertilisers during the time of refoliation, *i.e.* late February to early April in the S.W. monsoon zone, or in suitable weather in August/September. Where the land has not been cultivated for some years we consider it wiser to resume manuring with two relatively small applications at an annual interval rather than one big dose with an interval of two years before the next application is made. Largely because the encouragement of leguminous covers is usually one of the objects on resuming a manuring programme, we recommend a complete NPK mixture for the first application in the proportions 4 : 2 : 1.

Experiment on Dartonfield.—The third year of this experiment was completed at the end of 1938, but the figures are not available for inclusion in this report. The results for 1937, the first year after the initial application, were fully reported in a paper in Quarterly Circular, Vol. 15, Part 1, and are summarised in Table VI.

Yield.—As for the tapping experiment described above, the yields have been adjusted by means of a regression on the preliminary figures for 1936. Judged by the conventional standard of a 20 : 1 probability the treatment effect is just significant, and differences of 7.7 lb. per plot or more are real. On this

basis the yield of the control plots is seen to be significantly lower than that of any of the manured plots except NP. The latter, however, does not differ significantly from the other fertiliser treatments. One would therefore conclude that nitrogen, by itself and with the minerals, has exercised a beneficial effect on yield in the first year, but for the present we prefer to regard the response as being rather dubious partly because, owing to an unfortunate random distribution, the yield of the "control" plots was appreciably lower even in the preliminary year, and partly because there is no evidence of a treatment effect in the growth measurements.

There was no indication of any difference between the two methods of application, viz., forking and broadcasting.

Girth Increment.—No significant differences. The average rate of increase, 0.61 inch in 10½ months, may be regarded as fairly satisfactory and a rapid response to the manures is unlikely to be shown.

TABLE VI
Manuring Experiment

Treatment	Adjusted Yield, 1937		Girth Increment Mar. '37-Jan. '38	Bark Renewal (12 months)
	lb. per plot (20 trees)	Percentage of "control"		
N	109.6	111.2	0.56 inch	4.8 mm.
NP	104.5	105.0	0.67 „	4.7 „
NK	108.0	109.5	0.62 „	4.8 „
NPK	109.1	110.6	0.64 „	4.8 „
O	98.6	100.0	0.55 „	4.9 „
Mean	106.0	—	0.61 „	4.8 „
Significant Difference ($P=.05$)	7.7	7.8	Differences not significant	

Bark Renewal.—No significant differences. The figures in Table VI differ from those given in the paper published in the Quarterly Circular by 5 per cent. as it has been found that the instrument used is subject to a fairly constant error of this magnitude.

Ground Cover.—The most striking visual effect of the fertilisers was the response of the cover of *Pueraria phaseoloides* to phosphate (Safaga). Neither nitrogen nor potash appears to have had any effect.

2. Young Buddings

Experiments at Dartonfield.—The experiments on the fertiliser requirements of young buddings on replanted land at Dartonfield are referred to under the heading Replanting.

Experiments on Estates.—Advice has been given to a number of estates wishing to lay down manuring experiments in replanted clearings. A simple randomised block design with the eight elementary treatments of N, P and K at two levels (0 and 1) and four replications has been suggested. On one estate a 27 plot experiment with the nutrients at three levels has been started. With the appointment of a Soil Chemist we shall be able to exercise a greater degree of control over these trials, and they should provide valuable data on the fertiliser requirements of young buddings in different localities. No results are available for inclusion in this report.

Compost Experiment.—In August, 1937, an experiment was started in the 1935 Clearing at Nivitigalakele to compare the value of compost with an artificial fertiliser mixture with the same NPK values. Thirty-eight plots of buddings of local clones are used for the purpose, each plot of 24 trees being divided into two halves, one of which receives the compost and the other the artificial mixture. The first application was made in August, 1937, and the second in August, 1938. At the second manuring both sub-plots were given added phosphate as the level of this nutrient in the compost is too low to be suitable for young plants.

The girth measurements made in 1937 and 1938 are given in Table VII. There is no significant difference between the two treatments. The costs of the 1937 application were approximately Rs. 16 per acre for the compost and Rs. 8 per acre for the artificial mixture, the high cost of the compost being due to heavy transport charges. The low general level of growth is due to the inclusion of a particularly poor area of “damana” land.

TABLE VII

Girth Measurements in Inches

	1937	1938	Increase 1937/38
Compost	4.42	6.74	2.32
Artificial Mixture	4.44	6.85	2.41

C. Cover Crops

General.—The resumption of manuring programmes has facilitated the establishment of leguminous ground covers on estates, and it is probably true to say that most estates now carry a satisfactory cover in their mature areas. The species most commonly planted is *Pueraria phaseoloides*.

Natural Covers.—Reference has been made in previous reports to an area of 20 acres on Dartonfield on which a trial of natural covers is being made. Except for the removal of certain grasses and the periodical thinning of the fern *Blechnum orientale*, no weeding has been undertaken since the beginning of 1936. Owing to the slow rate of establishment of desirable types of cover the whole area was forked and manured with a nitrogen-phosphate mixture early in 1938. Since it was feared that the residual *Vigna* might be so stimulated by the manure that it would suppress the growth of young seedlings brought to activity by the soil disturbance, this cover was removed from half the area. The *Vigna* has certainly benefited from the manure but does not appear to have impeded the growth of natural covers.

The tempo of the regeneration process still remains slow though there has been some progress during the year, particularly in a rather low-lying portion of the area. Several new species of a desirable type have been noted, but none fills a predominant rôle in the flora. Particular attention had to be given to a grass *Lophatherum gracile* which was rapidly establishing itself in colonies, and this is now periodically removed. All erect covers growing in a line 6 ft. wide down each row of trees were twice lopped to ground level, but otherwise no lopping was done.

D. Replanting

As in the past few years problems connected with replanting occupy a large part of the time spent in advisory work. The experimental data and practical experience derived from the replanted areas on Dartonfield are invaluable in providing a basis for advice. The results of these experiments are published annually in the Quarterly Circular, and the conclusions formed during 1938 are summarised below.

Experiment No. 1, 1934 Clearing (7½ Acres).—This area was replanted with budded stumps in June, 1934, the purpose being to compare: (1) methods of disposal of the old timber; (2) species of ground cover crops; and (3) methods of controlling the ground cover. The mean girth measurements for the various experimental treatments in 1936, 1937 and 1938, and the increments during the year 1937-38, are given in Table VIII.

TABLE VIII

Budded Stumps Planted, June, 1934.

Girth in Inches at 3 Feet from Union

Treatments	1936 Age 2 years	1937 Age 3 years	1938 Age 4 years	Increase 1937-38
<i>Species of Cover</i>				
1. <i>Centrosema pubescens</i> ...	5.16	8.93	13.40	4.47
2. <i>Pueraria phaseoloides</i> ...	4.95	8.61	13.56	4.95
3. <i>Calopogonium mucunoides</i> ...	5.51	9.36	13.83	4.47
4. <i>Dolichos Hosei</i> (Vigna) ...	5.43	9.66	14.49	4.83
Mean	5.26	9.14	13.82	4.68
Significant difference ...				
($P=0.05$)	Not significant	0.64	0.61	Not significant
<i>Timber Treatments</i>				
A Leaving all main stems lying unburned	5.38	9.38	14.06	4.68
B Burning all timber on the land	5.19	9.16	13.94	4.78
C As B, but also removing and burning all larger lateral roots	5.22	8.88	13.46	4.58
Mean	5.26	9.14	13.82	4.68
Differences... ..		Not significant		
<i>Control of Cover</i>				
X Keeping platforms clean weeded	5.30	9.17	13.76	4.59
Y Ring weeding in 6 ft. dia- meter circle	5.22	9.10	13.88	4.78
Mean	5.26	9.14	13.82	4.68
Differences... ..		Not significant		

The only difference which is statistically significant is that between the trees growing in the Vigna plots and those with the other covers. Vigna is the least vigorous of the four covers and it may be assumed that the superior growth of the trees is due to less competition for food and water.

In view of the difference of opinion regarding the use of *Pueraria* in new clearings, it is interesting to note that although for the first three years this species appeared to retard the growth of the young plants most, during the fourth year the increase in girth in these plots has been greatest. This suggests that the retarding effect of a heavy ground cover, which is a predominant factor in the early years, is now being counter-balanced by the benefits due to that cover. That the ground covers are no longer seriously competitive is also evidenced by the general increase in the rate of growth—4.68 inches for 1937-38 as compared with 3.88 for 1936-37—and the slight tendency for the trees which are only ring weeded to gain on those planted on clean weeded platforms.

Experiment No. 2, 1935/38 Clearing (13 + 6½ Acres).—As recorded in the Annual Report for 1937, this experiment was considered unsatisfactory owing to the discovery of a "rogue" mixed with the clone Tjirandji I, and it was decided to re-commence the experiment in 1938 and to replant a further block so as to increase the number of replications to six. Before uprooting the 1935 budgrafts measurements of girth were made and the figures are given in Table IX.

TABLE IX
Girth in inches at 3 Feet from Union

Treatment	N ₁	N ₂	N ₁ P	N ₂ P	N ₁ K	N ₂ K	N ₁ PK	N ₂ PK	O	Mean
July, 1937 ...	4.34	4.81	4.92	5.04	5.01	5.33	4.84	5.22	4.97	4.94
April, 1938 ...	5.64	6.44	6.92	7.11	6.94	6.88	6.73	7.14	6.50	6.70
Increase, 1937-38	1.30	1.63	2.00	2.07	1.93	1.55	1.89	1.92	1.53	1.76

With only three effective replications the experiment was insufficiently precise for small differences to be indicated with certainty, but there is a strong suggestion of a response to phosphoric acid.

The areas were replanted with budded stumps in May/June, the following clones being used (one for each replication):—TJ. I, P.B. 86, P.B. 183, P.B. 186, W. 259, HC. 28. The fertiliser treatments are the same as before except that the two levels of nitrogen have been reduced from 2 and 1 to 1 and 0. The former N₁ treatment has been replaced by compost brought up to the nutrient status of the NPK mixture by the addition of P & K.

The manures were applied according to the experimental requirements at the time of planting, being well mixed with the soil throughout the upper half of the hole. In November, *i.e.*, 5½ months from planting, the height of each individual plant was measured and there was no indication of any treatment response.

Experiment No. 3, 1936 Clearing (10 Acres).—The following series of comparisons are being made in this area:—

Methods of Opening—

1. Planting on contour platforms.
2. Planting in contour trenches.
3. Contour planting, with level pitted drains between the contours.

Methods of Planting—

- A. Planting budded stumps (Planted, May, 1936).
- B. Planting stumped buddings (Planted, May, 1936).
- C. Planting one basket plant and four germinated seed in each hole for subsequent budding in the field. (Planted, September, 1936, and mostly budded November-December, 1937).

Manuring—

- X. A complete inorganic mixture.
- Y. A complete organic mixture.

Measurements were made in June, of girth in the case of the budded stumps and stumped buddings, and of height in the case of the plants budded in the field, and the figures are given in Table X.

Methods of Planting.—As is to be expected at this stage the stumped buddings are substantially bigger than the budded stumps, the difference between the means of all treatments being 2·35 inches, and it remains to be seen whether the advantage will be maintained. For the stumped buddings it is possible to give the increases in girth during the year 1937-38, and the mean figure of 3·34 inches, may be taken as showing satisfactory development. 6·21 inches for the mean girth of the budded stumps at two years old is also very satisfactory

The field buddings can hardly as yet be compared with the other methods of planting. The measurements were made at a time when some of the buds had not yet sprouted and therefore had to be given a “nil” value. The average height for those plants successfully budded in 1937 and cut back in December was 7·48 feet.

Methods of Opening.—Owing to the fact that the measurements are not in the same units for all methods of planting it has not been possible to make a combined analysis. Taking each method of planting separately, the differences between the methods of opening are in no case found to be significant by the conventional 20 : 1 standard, though in the case of the budded stumps and field buddings they are nearly so. If, however, the figures for budded stumps and stumped buddings are combined, as may legitimately be done, the error is reduced and a significant treatment response is shown. There is no difference between the growth on the platforms and in the trenches, but both are significantly better than the drains.

Organic vs. Inorganic Manuring.—There is no significant difference in growth, but as regards cost the figure for the organic mixture up to June, 1938, was Rs. 18/- per acre and for the inorganic mixture only Rs. 11 per acre.

TABLE X
Measurements made in June, 1938

Treatment	A. Budded Stumps	B. Stumped Buddings		C. Budgrafts from Seed-at-stake
	Mean girth in Inches	Mean girth in Inches	Increase 1937-38	Mean Height in feet
1. Contour platforms ...	6.34	8.88	3.52	6.92
2. Contour trenches ...	6.57	8.62	3.33	6.36
3. Pitted drains ...	5.70	8.21	3.22	4.45
Mean ...	6.20	8.57	3.36	5.91
Differences ...		Not significant		
X. Inorganic Manure ...	6.13	8.50	3.26	6.27
Y. Organic Manure ...	6.28	8.64	3.45	5.55
Differences ...		Not significant		

Miscellaneous

Weeds Manual.—The writer has served on the Committee for the compilation of a Manual on Weeds, and notes were made on the first batch of 50 weeds which are to the subject of the initial issue.

Leaf Anatomy.—An investigation was commenced on the anatomy of leaves of various clones with particular reference to cuticle thickness. It was thought that it might be possible to correlate clonal susceptibility to fungus and insect attack on the leaves with variations in the thickness of this structure, but although constant clonal differences can be noted these do not appear to be related to field observations.

ADVISORY WORK Identification of Clones

During the course of visits to estates towards the end of 1937 and early in 1938 it was noticed that there was often a considerable degree of confusion in both nursery and field between the various imported clones being used for replanting. As the demand which arose for the services of an officer to check the identity of clones was too great to be met by the existing staff without dislocating the work of Senior Technical Officers, arrangements were made with the Rubber Research Institute of Malaya for the loan of one of their Chinese budding mandors who is experienced in this work. The writer was responsible for arranging the itineraries for this officer and laboratory assistant who accompanied him as interpreter. The work was still in progress at the end of the year, up to which time 90 estates had been visited. Full reports were submitted in all cases.

The outcome of these visits, though hardly satisfactory to some of the estates on account of the considerable mixing of clones revealed, has at least justified the engagement of these officers' services, and there is no doubt that the work when completed, will have been of incalculable value to the local industry in preventing further errors. Estate Superintendents have not been backward in recording their appreciation of the service, and the Research Scheme, in turn, is greatly indebted to the Malayan Institute for this practical example of co-operation.

Estate Visits

The following visits were paid :—

Officer			Advisory			Experimental	Identification of Clones
R. K. S. Murray ...	...	...	54	...	9	...	7
C. A. de Silva ...	...	...	—	...	—	...	18
C. E. Ford ...	...	...	—	...	3	...	—
L. A. Whelan ...	...	...	—	...	1	...	—
			54			13	25

Specimens and Enquiries

Specimens were received for report from 175 estates.

Enquiries were dealt with on the following subjects (figures for 1937 in brackets) :—

Botanical—

Budding and allied subjects (including choice of planting material)							
						331	(133)
Replanting procedure						64	(55)
Nurseries						19	
Manuring						102	(67)
Cover crops... ..						36	(33)
Tapping						13	(21)
Miscellaneous planting matters						34	(83)
						599	(392)

Pathological—

Oidium and sulphur dusting		52	(34)				
Root disease... ..		17	(31)				
Miscellaneous		62		131	(65)		
Total				730	(457)		

Correspondence amounted to 1,996 inward and 2,120 outward letters.

Visitors

Personal interviews with visitors constitute one of the most useful features of advisory service, and there were 136 visitors to the laboratories during the year. Many of these were conducted round the field experimental areas. This figure includes 51 visitors on the Field Day arranged after the Rubber Conference at Tebuwana.

Lectures

The following lectures were given during 1938 :—

Venue	Subject	Lecturer
Sabaragamuwa P. A.	...*Root Disease with Special Reference to Replanting ...	R. K. S. Murray
Southern Province P. A.	*The Care of Young Budded Trees	do.
Kurunegala P. A.	... The Choice of Clones for Dry Districts ...	do.
Rubber Conference	...*The Budgraft as a Composite Plant ...	do.
	*Oidium Leaf Disease ...	do.
Kelani Valley P. A.	... The Identification of Clones ...	C. E. Ford
Rubber Conference	...*The Principles of Plant Breeding and their Application ...	do.

*Reproduced in Quarterly Circular.

PUBLICATIONS

In addition to the lectures mentioned above the following papers were published :—

1. Field Experiments on Dartonfield Estate—VI.—Quarterly Circular, No. 15, Part 1. R. K. S. Murray and C. A. de Silva.
2. Planting Notes.—Quarterly Circular, Vol. 15, Part 1. R. K. S. Murray.
3. Planting Material.—Quarterly Circular, Vol. 15, Part 1. R. K. S. Murray.
4. The Performance of Imported Clones in Ceylon—II.—Quarterly Circular Vol. 15, Part 2. R. K. S. Murray.
5. Ceylon Clones—VI.—Quarterly Circular, Vol. 15, Part 2. R. K. S. Murray.
6. Field Experiments on Dartonfield Estate—VII.—Quarterly Circular, Vol. 15, Part 3. R. K. S. Murray and C. A. de Silva.

(Sgd.) R. K. S. MURRAY,
Botanist and Mycologist.

Research Laboratories,
Agaawatta.

3rd February, 1939.

REPORT OF THE SMALLHOLDINGS PROPAGANDA OFFICER FOR 1938.

A feature of special interest in the report for 1937, it may be recalled, was the inauguration of active rubber smallholdings work in Ceylon by the Rubber Research Scheme. The present period under review may be regarded as of similar interest in reviewing the progress made and the expansion of such work. The Board's decision (at the end of 1937) to extend the work of the Smallholdings Department by the appointment of four additional Rubber Instructors (making a total of six) was given effect to during the early part of the year and resulted in a considerably increased sphere of activity for the Department's work.

Staff

(a) *Rubber Instructors*.—The five new Rubber Instructors selected in December, 1937, reported for duty on January 17th, four of them being for the four new ranges and the fifth to replace the vacancy in the Matugama range. One of the officers who did not find the work to his taste, relinquished his office during the period of preliminary training and a new appointment was made on April 4th. At the conclusion of the usual special training which lasted about three months, the new Instructors were assigned to ranges as follows :—

*Mr. N. T. M. C. de Silva to Galle on April 9th.

*Mr. D. P. Gunawardane to Ruanwella on April 9th.

*Mr. H. P. G. Peiris to Katugastota on April 9th.

Mr. B. D. Pedrick to Matugama on May 16th.

*Mr. L. A. Peiris to Ratnapura on June 4th. (Delay was due to absence on sick leave).

* New Ranges.

At the end of August Mr. D. P. Gunawardane resigned his post having secured more remunerative employment elsewhere and was replaced by Mr. H. B. Wijesundara on October 1st. Following the short notice of this resignation which caused some inconvenience to the Department, the conditions of employment of instructors were amended by the Board to require three months' notice of resignation on either side in future instead of one.

All the new Instructors, in spite of certain adverse circumstances against making headway in their work, such as the low price of uncouped rubber that prevailed during the year, have made very satisfactory progress in their respective ranges.

Mr. H. K. Wijeyasinghe, Rubber Instructor, Horana, continued his duties in this capacity and also did part-time work in the Matugama and Ruanwella ranges for certain periods pending the appointment of Instructors for these ranges.

(b) *Clerk and Translator*.—Mr. A. A. Silva continued in this capacity and was responsible for the Sinhalese translations of leaflets issued by the Department and all clerical work in the office.

Demonstrations

Practical demonstrations given by the Instructors to groups of smallholders formed one of the principal means of propaganda employed. The number and variety of these demonstrations, as given by each Instructor, were limited both by other demands on his time and by the existing need for a particular kind of demonstration but an effort was made to give a certain minimum number each month. The number of demonstrations given by each Instructor during the year (or such part of it as he was on duty) is shown at the summary at the end of this report. While sheet-making, budding and tapping continued to form the main kinds of demonstrations given, a number of other demonstrations in disease treatment, compost making, measures for preventing soil erosion, making budding tape, germinating and planting seed in nurseries, etc., were also given.

Replanting

(a) *General*.—The extensive replanting operations which have been so evident in Ceylon during the year have not failed to interest the smallholder and there has been a steadily increasing demand for service and assistance in this connection. Besides visiting holdings and directing replanting operations. Instructors have “lined” for contour drains and holes, a number of holdings free of charge (see summary at end). In most of the ranges a few holdings have already been replanted and others are in varying stages of completion (see summary). Considerable more work in this connection is anticipated in 1939

Costs of replanting under smallholdings conditions were worked out and embodied in the revised leaflet on replanting that was issued during the year.

(b) *Demonstrational*.—The opening up of a small replanted block for purposes of demonstration was completed in each of the four new ranges as well as in the Matugama range. All the blocks opened were $\frac{1}{2}$ an acre in extent except the one at Ruanwella which was $\frac{1}{4}$ acre owing to the owner not possessing sufficient Rubber. The blocks are opened by mutual arrangement with private owners (smallholders) at Rubber Research Scheme expense, the owner usually contributing the cost of one or two items such as fencing. The block is selected at a prominent junction or adjoining a main road and the work carried out on the basis of a written agreement. The Matugama block was planted with budded stumps in June and the four other blocks in December. In spite of abnormal weather conditions during the year, planting of all blocks was fortunately followed by favourable weather.

The demonstration replanted block at Kahatapitiya in the Horana range (planted in October, 1937) has made satisfactory progress, but the growth in the Ratmalgoda block has been retarded by neglect on the part of the owner to keep it properly weeded. Height and girth measurements taken ten months after planting showed the average height and girth (at 3 ft. from union) per plant at Kahatapitiya to be 70.9 inches and 2.0 inches respectively and at Ratmalgoda 51.9 inches and 1.3 inches respectively. The growth at the Kahatapitiya block may be considered satisfactory in view of the fact that no artificial fertiliser at

all has been added. Both blocks were manured with three baskets of cattle manure per plant in September.

Competitions

Twenty-four and 21 entries respectively were received for the competitions for the "best kept holding" and the "best smoked sheet" in the Horana range. All holdings were visited both by the writer and the range Instructor, and instructions and demonstrations in recommended improvements given by the latter from time to time. Nineteen of the outstanding holdings were re-visited by the writer in December for adjudging the winners for the final approval of the Director.

The competitions have proved a great inducement to owners to follow the measures recommended by the Department and some very good work has been done particularly in the competition for the best kept holding. Improvements fairly generally effected consisted of the cutting of contour drains and silt pits, making of compost and its application to trees, improved tapping, planting of cover crops, cleanliness of utensils, etc. In the sheet competition, which has helped to improve both the quality of sheet and the condition of smokehouses, some of the sheet produced was of exceptionally good quality and finish.

Smokehouses

(a) *General*.—Although the prices of rubber (particularly uncouponed rubber which affects the smallholder) have not been very favourable during the year, it will be seen that quite a satisfactory number of smokehouses (see summary), modelled on the lines of the demonstration houses recommended by the Department, have been put up by private owners in the different ranges under the guidance of the Rubber Instructors. For instance in the Galle range, to which an Instructor was only appointed in April, eight houses other than demonstration houses have been completed while two others are under construction. Considering that there was hardly any tapping on smallholdings till the middle of June, this is particularly gratifying. It is felt that with market prices affording sufficient inducement for smallholders to tap their rubber, there is likely to be a considerable demand for these cheap but efficient little smokehouses in the future. Improvements to a number of existing smokehouses have been effected on the advice of the Rubber Instructors.

(b) *Demonstration Smokehouses*.—4, 4, 2 and 1 demonstration smokehouses were constructed by the Department in the Ratnapura, Ruanwella, Katugastota and Galle ranges respectively while two others in the Katugastota range are nearing completion. A demonstration in sheet making was given at each completed house and Instructors report that the owners concerned are getting top prices locally for their sheet. Some of the sheet being made has been seen by the writer and is of very good quality while there is room for further improvement in others.

Information regarding the demonstration smokehouses was sent to the

Rubber Research Institute of Malaya on request, together with samples of sheet smoked in them.

Specifications and plans of both types of smallholders' smokehouses recommended by the Department were included in leaflet S.H. 3 issued during the year.

Planting Material

Eight hundred and forty-one budded stumps and 99 yards of budwood were sold to smallholders through the Department. Consequent upon the decision of the Board to confine the issue of planting material in 1939 to smallholders, the allocation of material for 1939 was taken over and approximately 9,000 budded stumps and 500 yards of budwood have been booked for 1939 South-West delivery only.

Nurseries

4, 4, 6 and 3 seedling nurseries for giving budding demonstrations to smallholders were opened by the Department in the Galle, Katugastota, Ratnapura and Ruanwella ranges respectively. Each nursery is 4-6 perches in size. A few private nurseries (see summary) have also been opened with the assistance of the Instructors in anticipation of future planting.

The Horana and Matugama nurseries (planted in 1937) have been maintained in good order and a few of the plants were ready for budding at the end of the year.

Compost

Small scale experiments in preparing compost were carried out and suitable recommendations made in Leaflet S.H. 1 (revised). It was found that a useful compost could be made in $2\frac{1}{2}$ months with garden refuse, leaf cuttings and cow manure by heaping them in shallow uncovered pits, turning the heap every two weeks and keeping it moist. A number of pits have been opened by smallholders (see summary at end) who appear to be taking kindly to the idea and a vote for 1939 for a couple of demonstration pits in each range was provided for.

Forestry Block

A small block of mature Rubber in the Matugama range was, with the owner's permission, brought under the "forestry" or "natural cover" method of cultivation, as an experiment. This consists of allowing property controlled contour belts of suitable jungle weeds to grow between the rows of Rubber in place of nitrogenous covers, especially where the latter are expensive or difficult to establish. The rows of Rubber were clean weeded leaving belts of the existing "cheddies" in between, and the growth of the latter was encouraged by lopping the taller ones and allowing the loppings and weedings to decay on the ground.

Testing of Coagulants

Samples of coagulants were purchased from 12 local dealers in the Matugama range and submitted to the Chemist for testing. The latter found five

of the samples to be formic acid of normal strength, while one appeared to be slightly diluted but was sold slightly cheaper probably to attract custom. Four were normal samples of acetic acid though the price of one was much in excess of what it should be. One was a sample of acetic acid, which though of normal strength, showed impurities; while one was acetic acid sold and charged for as formic acid. Dealers who were selling unsuitable material were duly warned. The writer's thanks are due to the Chemist for the analyses.

Shows

The Department participated in the Ruanwella Agricultural, Industrial and Health Exhibition in March and in the Pata and Uda Dumbara Agricultural, Educational, Industrial Health Show at Teldeniya in July, on the invitation of the organising authorities. The Rubber Research Scheme stall, which displayed and explained various vulcanised rubber and smallholdings exhibits, was visited by large numbers of smallholders. An address in Sinhalese, explaining the work of the Smallholdings Department, was given by the writer at the Teldeniya Show. Participation in such shows when held in Rubber districts is felt to be of considerable propaganda value.

Publications, Posters, Etc.

The following leaflets were issued in Sinhalese and in English :—

1. "The Preparation of Smoked Rubber Sheet"—Leaflet No. S.H. 3.
2. "Replanting of Rubber" (Revised)—Leaflet No. S.H. 1.

A paper on the "Work of the Smallholdings Department of the Rubber Research Scheme" was read at the Rubber Conference held at Tebuwana in November under the auspices of the Planters' Association of Ceylon.

A design for a poster for the Smallholdings Department prepared by Mr. N. T. M. C. de Silva, Rubber Instructor, Galle, was approved by the Smallholdings Committee and quotations for printing it in colour were obtained.

Correspondence

Correspondence during the year which was partly in Sinhalese was as follows :—

Inward	...	...	...	...	...	...	...	...	957
Outward	...	...	...	...	...	...	...	...	775

General

Visits of supervision and inspection were paid to the four distant ranges—Galle, Katugastota, Ratnapura and Ruanwella—on an average about once in six weeks or two months, and to the nearer Horana and Matugama ranges more frequently as was necessary.

Special Quarterly Summary Forms were prepared and issued to Instructors for submitting summaries of work done by them each quarter.

Notice boards in Sinhalese directing smallholders to the local Instructor for particulars were erected opposite all demonstration replanted blocks and smokehouses in the Horana and Matugama ranges.

The writer continued as a member of the Smallholdings Committee.

(Sgd.) W. I. PIERIS,
Smallholdings Propaganda Officer.

Smallholdings Department,
Matugama.

D = Demonstrational.
O = Other.

Summary of Instructors' Work.

Instructor and Period of Duty	DEMONSTRATIONS					Smokehouses	Replanting	Nurseries	Compost Pits	Other Main Work
	Sheet making	Budding	Tapping and Markg.	Disease Treatment	Other					
1. Rubber Instructor, Horana. Jan. to Dec., 1938.	30	8	34	8	32	8 completed (O)	15 (O)	7 (O)	14 (O)	3 holdings budded. Soil conservation measures (contour drains, etc.) on 10 mature Rubber holdings. 2 competitions. 4 smokehouses improved. Help in filling new planting and other applications.
2. Rubber Instructor, Ratnapura. June to Dec., 1938.	8	16	10	19	25	4 completed (D) 2 started (O)	1 (D) 1 (O)	6 (D) 5 (O)	4 (O)	167 plants budded. 110 Questionnaire forms filled. 1 smokehouse improved. 100 new planting, replanting and nursery application forms filled.
3. Rubber Instructor, Galle. April to Dec., 1938.	4	14	24	27	23	1 completed (D) 8 completed (O) 2 started (O)	1 (D) 6 (O)	4 (D)	10 (O)	9 holdings contour drained. 5 holdings and nurseries budded. 3 holdings planted with cover crops. 21 new planting and replanting application forms filled. 1 smokehouse improved.
C. forward ...	42	38	68	54	80	21 completed 4 started	24	22	28	

Summary of Instructors' Work—Contd.

Instructor and Period of Duty	Sheet making	DEMONSTRATIONS				Smokehouses	Replanting	Nurseries	Compost Pits	Other Main Work
		Budding	Tapping and Markg.	Disease Treatment	Other					
B. forward ...	42	38	68	54	80	21 completed 4 Started	24	22	28	
4. Rubber Instructor, Katugastota. April to Dec., 1938.	4	9	3	2	9	2 completed (D) 3 started (D) 1 completed (O)	1 (D) 7 (O)	4 (D) 2 (O)	4 (O)	6 holdings budded. 2 holdings lined for drains 20 replanting applications submitted. Over 200 new planting application forms filled.
5. Rubber Instructor, Matugama. May to Dec., 1938.	10	11	5	7	6	1 completed (O) 3 started (O)	1 (D) 6 (O)	6 (O)	7 (O)	3 holdings contour drained. 1 "forestry" block.
6. Rubber Instructor, Ruanelia. April to Aug. and Oct. to Dec., 1938.	2	2	4	5	5	4 completed (D)	1 (D) 1 (O)	3 (D)	4 (O)	2 holdings contour drained. 10 replanted holdings visited. 2 smokehouses improved.
Total ...	58	60	80	68	100	29 completed 10 started	41	37	43	

ESTATE SUPERINTENDENT'S REPORT FOR 1938. DARTONFIELD.

Acreage Statement and Census

No. of Field	Acreage	No. of Immature Trees	No. of Mature Trees	Total
<i>Mature Areas—</i>				
1	29·3·29 ...	82 ...	2,962 ...	3,044
2	0·3·36 ...	— ...	75 ...	75
3	32·0·30 ...	— ...	3,190 ...	3,190
4	1·1·03 ...	— ...	174 ...	174
6	58·2·10 ...	— ...	5,529 ...	5,529
<i>Replanted Areas—</i>				
1	7·3·07 ...	831 ...	— ...	831
2	12·2·10 ...	1,395 ...	— ...	1,395
2a	6·2·35 ...	780 ...	— ...	780
3	9·1·10 ...	1,216 ...	— ...	1,216
Buildings and Roads ...	14·3·08			
Scrub, etc.	2·2·19			
Total ...	176·2·37	4,304	11,930	16,234

Revised acreage figures were determined by a re-survey undertaken during the year.

Rainfall.—Rainfall amounting to 15·1·85 inches was below average and the distribution abnormal. Both monsoons were a failure and weather conditions were relatively wet during the normal dry months. An increase in the number of wet days was recorded despite the low rainfall figure.

Details of rainfall during 1938 and the preceding year appear below :—

	1937	1938
January	11·11 ins. ...	5·70 ins.
February	9·17 „ ...	15·07 „
March	5·09 „ ...	11·19 „
April	21·51 „ ...	25·52 „
May	36·34 „ ...	12·76 „
June	8·81 „ ...	8·47 „
July	20·36 „ ...	11·00 „
August	7·88 „ ...	11·47 „
September	18·06 „ ...	21·27 „
October	16·88 „ ...	7·01 „
November	19·96 „ ...	6·73 „
December	5·35 „ ...	15·66 „
Total ...	180·52 ins.	151·85 ins.

Crop.—Crop for the year amounted to 71,218 lbs. against an estimate of 72,000 lbs.

Field No.	Total Crop lbs.	Acreage tapped	Yield per Acre lbs.
No. 1	15,811	29	545.2
No. 2	1,109	1	1,109.0
No. 3	17,759	32	559.9
No. 4	1,737	1½	1,158.0
No. 6	34,802	58½	594.9
Total	71,218	122	583.8

Percentage of estimate harvested—98.9 per cent.

Crop figures for the Forestry area, which forms part of Field No. 1, are as follows :—

	1937	1938
January-June	5,665 lbs.	5,009 lbs.
July-December	7,636 „	7,404 „
Total	13,301 lbs.	12,413 lbs.

Tapping.—Tapping remained on the double-four system and a satisfactory standard of yield has been maintained. Bark consumption averaged 3¼ inches on each side.

The tapping in experimental areas was under the supervision of the writer as in former years.

Analysis of Tapping Rounds

	Early tapping	Late tapping (before 10 a.m.)	Very late tapping	Partial washout	Washout	No tapping due to Rain	Holidays
January... ..	28	1	—	—	—	—	2
February	11	1	1	—	1	2	—
March	16	2	—	—	—	—	—
April	20	—	7	3	—	2	1
May	22	1	2	2	2	4	2
June	23	—	7	6	—	—	—
July	23	3	2	1	1	3	—
August	14	1	11	2	—	5	—
September	13	4	9	3	—	4	—
October	24	2	3	—	—	—	2
November	27	2	1	1	—	—	—
December	24	4	3	—	—	—	—
	245	21	46	18	4	20	7

Average Intake per Tapper

January	...	...	...	...	...	...	10.2 lbs.
February	...	...	...	...	...	...	8.5 "
March	...	...	...	...	...	...	4.5 "
April	...	...	...	...	...	...	8.5 "
May	...	...	...	...	...	...	8.3 "
June	...	...	...	...	...	...	7.2 "
July	...	...	...	...	...	...	8.6 "
August	...	...	...	...	...	...	8.3 "
September	...	...	...	...	...	...	8.7 "
October	...	...	...	...	...	...	10.6 "
November	...	...	...	...	...	...	7.3 "
December	...	...	...	...	...	...	10.0 "

Manufacture.—The crop was mainly prepared in the form of crepe. This was due partly to market conditions and partly to the fact that the normal sheeting equipment was replaced by a sheeting battery which was under trial at intervals during the year. Small shipments of ammoniated latex and nitrite crumb were prepared.

Details of grades are as follows :—

Grades	lbs.	Percent.	Total
Smoked Sheet, No. 1	4,138	5.81	6.05
Do. No. 2	102	.14	
Do. No. 3	70	.10	
Latex Crepe, No. 1	44,423	62.38	65.56
Do. No. 2	2,099	2.95	
Do. No. 3	160	.23	
Scrap Crepe, No. 1	5,016	7.04	15.03
Do. No. 2	5,693	7.99	
Crumb Rubber	3,810	5.35	13.36
Latex	5,707	8.01	

Machinery.—Machinery and electrical installations were inspected by Messrs. H. W. Hammond & Co., Consulting Engineers in February.

Factory machinery has been maintained in good order at reasonable cost. An improved type of water pump was fitted to the Lister engine.

Additions to factory equipment included :—

A (Guthrie Cadet) sheeting battery installed by Messrs. Brown & Co., Ltd., for demonstration and trial.

Two second-hand 12 ins. crepeing mills for milling rubber samples.

Details of fuel consumption are given below :—

		Large Engine (Ruston Hornsby, 52-57 H.P.)			Small Engine (Lister, 9 H.P.)		
		Hours Worked	Diesel Oil Gals.	Lubric. Oil Gals.	Hours Worked	Diesel Oil Gals.	Lubric. Oil Gals.
1938		1,908	... 2,499	... 174½	... 1,747	... 722	... 53
Average per hour	...	—	... 1·31	... ·09	...	... ·41	... ·03
1937		1,918½	... 2,599½	... 178	... 1,558	... 764	... 31¾
Average per hour	...	—	... 1·35	... ·09	...	... ·49	... ·02

Pests and Diseases.—Owing to abnormal wet weather experienced prior to and during refoliation, the incidence of Oidium was unusually severe despite regular rounds of sulphur dusting. The effects of the treatment were largely nullified by rains experienced soon after dusting operations. Five rounds of sulphur dusting were carried out and consisted of a total application of 28 lbs. per acre.

Other diseases such as Ustulina and canker were not sufficiently severe to warrant any special attention other than routine methods of control.

Application of Cargillineum mixture A and a 3 per cent. solution of Izal to tapping cuts was carried out in wet weather as protection against bark rot.

Weeding.—Attention was given to the control of natural covers, twice during the year, except in the “Forestry” area which received special treatment. Woody plants such as the Local Rhododendrons (*Melastoma*) were cut below ground and any soft plants such as Veraniya (*Hedyotis*) and Kenda (*Macaranga*) were pruned to 1 ft. Self-sown rubber seedlings above 6 ft. in height were also cut down.

Forestry Area.—The control of both ground cover and indigenous plants was carried out in accordance with the recommendations of the Botanist.

Cultivation.—Manuring was completed in accordance with the programme detailed for the year. This involved the treatment of 53 acres of mature Rubber with a fertiliser mixture composed of 300 lbs. sulphate of ammonia and 75 lbs. concentrated superphosphate per acre. The fields treated consisted of 20 acres “Forestry” area in Field No. 1 (hitherto unmanured) and 33 acres from Field No. 6 which is now in the second cycle of manuring. The former and a small part of the latter, where the soil consisted of a hard pan, were deep forked in January. Manures were broadcast in March-April. Where application was made over a cover of Pueraria, the manure was brushed off effectively to prevent scorching of the leaves.

Cover Crop.—Attention was given to the re-establishment of Pueraria in backward areas, particularly around labourers’ quarters. Trials for eradicating snails in these areas were carried out very effectively with the use of a poison bait of meta and bran.

Labour.—The labour force of Tamils was adequate for normal estate requirements. There was a good demand for indigenous labour during the year. The turn-out in times of difficulty was generally encouraging.

The health of the labourers has been moderately good. Mass hook-worm treatment was administered by the Field Medical Officer to the resident labour force and a number of local Sinhalese. Two cases of typhoid fever and an outbreak of mumps occurred. Early precautions were taken in the former to prevent the spread of infection which originated from an outside source and inoculations were given to a number of contacts and others.

Monthly Total of Labour on Check Roll

					Tamils		Sinhalese		Total
January	...	...	...	...	69	...	43	...	112
February	...	...	...	...	65	...	45	...	110
March	...	...	...	...	55	...	93	...	148
April	...	...	...	...	59	...	90	...	149
May	...	...	...	...	62	...	77	...	139
June	...	...	...	...	62	...	68	...	130
July	...	...	...	...	64	...	41	...	105
August	...	...	...	...	54	...	42	...	96
September	...	...	...	...	50	...	48	...	98
October	...	...	...	...	48	...	48	...	96
November	...	...	...	...	51	...	55	...	106
December...	...	...	...	...	50	...	44	...	94

Figures for daily turn-out and rate of pay are as follows :—

Average daily out-turn	...	...	...	...	...	71
Average wages per day	...	...	...	...	...	43·7 cents

Cart Road, Roads and Paths.—Cart roads were maintained in reasonably good order throughout the year. A road extension was completed to the new senior staff bungalow.

Bridge to No. 5 Field.—A 34 ft. span foot bridge and suitable stepping stones were constructed across a stream for two approaches to this field.

Experimental Areas.—

No. 1 area replanted in 1934	...	...	...	...	7½ acres
No. 2 „ „ 1935 and 1938	...	...	...	...	12½ „
No. 2a „ „ 1938	...	...	...	...	6½ „
No. 3 „ „ 1936	...	...	...	...	9½ „

The writer has exercised supervision of routine work in the different clearings, in accordance with the instructions of the Technical Officers.

Field No. 2A.—A block of 6½ acres of mature Rubber was cleared and replanted under estate control in conformity with experimental requirements.

Buildings.—A Junior Staff bungalow and a motor shed for Senior Staff bungalow No. 4 were constructed under estate supervision. A factory store room was also completed during the year.

Maintenance of buildings, which comes within the purview of the estate department, received attention.

NIVITIGALAKELE

Acreage Statement—

Nivitigalakele Division.—

1926 Clearing	...	...	...	...	...	12 acres
1927 „	...	...	...	...	...	16 „
1928 „	...	...	...	...	...	33 „
Nurseries, buildings, gardens, etc.	...	...	...	...	...	8 $\frac{1}{2}$ „
Total						69 $\frac{1}{2}$ acres

Pinnagoda Division.—

1935 Clearing	...	...	...	...	...	28 $\frac{1}{2}$ acres
1935 Seedling nursery	...	...	...	...	...	1 „
1936 „	„	...	...	...	...	2 „
1939 Clearing	...	...	...	...	...	10 „
Budwood Multiplication nursery	...	...	...	...	...	6 $\frac{1}{2}$ „
Uncultivated	...	...	...	...	...	52
Total						100 acres

Rainfall.—124·89 inches.

Crop.—The crop harvested for the year amounted to 17,914 lbs. compared with an estimate of 12,250 lbs. Sixty-nine per cent. of the crop was derived from areas in commercial tapping and the remainder from areas in test tapping. The following is a summary of yield records for each field:—

Clearing				*Approx. Acreage in tapping	Crop lbs.		Yield per Acre lbs.	
1926 Clearing	...	...	...	10 $\frac{3}{4}$	...	5,491	...	510·8
1927 „	...	...	...	13 $\frac{3}{4}$	...	6,673	...	485·3
1928 „	...	...	...	15	...	5,750	...	383·3
Total				39 $\frac{1}{2}$	...	17,914	...	453·5

* These figures constitute only part of the total acreage.

Tapping.—Tapping was carried out in accordance with the instructions of the Botanist. Figures denoting the number of trees, in tapping, etc., are given below:—

Field and Clearing			Test Tapping		Commercial Tapping		Immature and/or not in Tapping		Total
12 acres,	1926 Clearing	...	283	...	818	...	326	...	1,427
16 „	1927 „	...	73	...	1,315	...	348	...	1,736
33 „	1928 „	...	793	...	672	...	1,259	...	2,724
Total			1,149	...	2,805	...	1,933	...	5,887

Manufacture.—Crop from commercially tapped areas was manufactured into smoked sheet and sold in Colombo at current rates. Test tapping samples were milled at Dartonfield and sold as scrap crepe. The distribution of grades is as follows :—

Grades			Lbs.	Per cent.		Total
Smoked Sheet No. 1	...	...	10,165	...	56.74	...
Do. No. 2	...	...	700	...	3.91	...
Do. No. 3	...	...	163	...	.91	...
Scrap Crepe No. 1	...	...	6,886	...	38.44	...

Pests and Diseases.—Although wintering was generally very irregular, the period of refoitation was relatively short. In consequence, the majority of clones escaped *Oidium* infection. The attack on some of the late wintering trees, however, was more severe than in former years.

Four rounds of sulphur dusting were carried out on the late wintering clones.

Manuring.—The whole area was manured in September with the following fertiliser mixture at 200 lbs. per acre :—

Sulphate of ammonia...	...	...	...	...	...	6 parts
Bone meal	...	...	...	...	...	1 part
Safaga phosphate	...	...	...	...	...	2 parts
Muriate of potash	...	...	...	...	...	1 part

In the 1926 and 1927 clearings and two acres of the 1928 clearing manure was lightly dibbled in between the rows of plants. In the remainder of the 1928 clearing, manure was forked in on platforms together with the incorporation of green manure.

Cover Crop.—Marcotted cuttings of *Pueraria* were planted out in the 1927 clearing with a view to establishing a cover of this species to replace the sparse cover of *Centrosema*.

Instruction in Budgrafting.—Thirteen courses of instruction in budgrafting were held for learners during the course of the year. 139 students attended.

Cart Road.—Construction of the cart road to Pinnagoda Division was completed in May.

Buildings.—Two Junior Staff bungalows were constructed under estate supervision.

Pinnagoda Division

1935 Clearing—28 Acres.

Cultivation.—With the exception of the area allotted to a compost experiment, the plants in this clearing were manured twice during the year with a complete fertiliser mixture as follows :—

(1) *Tjikadoe*, *Prang Besar* and other Seedlings received 2 lbs. of manure per plant, in two applications of 1 lb. each.

(2) *Plants Budded in the Field and Special Seedlings* received 1 lb. of manure per plant in two applications of $\frac{1}{2}$ lb. each.

Thirty-eight blocks of the earlier buddings of local clones which were allotted to a compost experiment, were manured in August according to experimental requirements.

Nurseries—

Budwood Multiplication Nurseries.—The clones have been separated by wire fences along the boundaries, in accordance with the regulations laid down for the introduction, multiplication and distribution of planting material.

The following imported clones were introduced during the year :—

A.V.R.O.S. 157	Prang Besar 5/57
A.V.R.O.S. 214	Prang Besar 5/60
Waringiana 4	Prang Besar 5/139
Pilmoor D/65	Prang Besar 6/9
Pilmoor B/84	Prang Besar 6/50

The multiplication of a number of promising local clones has also been undertaken.

1935/1938 Seedling Nursery—1 Acre.—This nursery was replanted during the seeding season in July/August. The initial growth of the seedlings is good.

1936 Seedling Nursery—2 Acres.—This nursery formed the main source of supply of budded stumps issued during the year.

Sale of Budded Stumps and Budwood.—Arrangements in regard to deliveries of budwood and budded stumps were entrusted to the writer's charge and have involved a considerable amount of work.

Total despatches of budwood and stumps were as follows :—

Budded stumps	...	...	...	...	...	...	7,447
Budwood	...	...	...	...	...	...	3,546 yards

Budding results for the season are as follows :—

					No. Budded		No. Successful		Per cent. Success
March	...	...	...	...	2,633	...	1,883	...	71
April	...	...	...	...	1,370	...	1,217	...	89
May	...	...	...	...	150	...	146	...	97
June	...	...	...	...	222	...	201	...	90
July	...	...	...	...	2,951	...	2,304	...	78
August	...	...	...	...	4,101	...	3,447	...	84
September	...	...	...	...	2,813	...	2,620	...	93
October	...	...	...	...	907	...	844	...	93
November	...	...	...	...	110	...	82	...	74
December...	...	...	...	...	862	...	654	...	76
Total					16,119		13,398		83

WAGOLLA

Budded Rubber Area.—Routine visits were paid by the Nivitigalakele Conductor and inspections were made by the writer in May and December.

Attention was given to the removal of *Gliricidias* and pollarding of low branches, with a view to improving the rate of drying of tapping panels in wet weather and reducing the risk of wind damage.

The growth of *Pueraria* over most of the area is good.

Contour pitted drains with silt pits, 8 ft. long, $1\frac{1}{2}$ ft. wide and 2 ft. deep, spaced 3 ft. apart and joined by shallow drains 6 inches deep, were cut. Four leader drains were opened out from convenient points to deal with the excess water. Owing to the difficulty of fitting drains between every two contour lines of trees, they were cut wherever possible.

(Sgd.) D. L. NICOL,
Superintendent.

Dartonfield Estate,
Agalawatta,
11th February, 1939.

REPORT OF THE LONDON ADVISORY COMMITTEE FOR RUBBER RESEARCH (CEYLON AND MALAYA) FOR 1938.

The Committee and Technical Sub-Committee held three meetings during the year. There were also two meetings of the Sub-Committee on Standardisation of Raw Rubber appointed in 1937.

Meetings of the Committee and Sub-Committee were attended by Mr. J. Wilson, Director of the British Rubber Producers' Research Association and Mr. W. W. Philpott, Chemist of the Rubber Research Scheme, Ceylon. Mr. G. E. de Silva, member of the Board of Management, Ceylon, and Mr. T. N. Dickson, Assistant Manager of the Experiment Station of the Rubber Research Institute, Malaya, inspected the work being carried out in the Committee's laboratories during their visits to this country on leave.

FINANCE

Contributions of £2,625 and £875 were received from the Rubber Research Institute and the Rubber Research Scheme respectively towards the cost of the work of the Committee during the year 1938. The expenditure incurred amounted to £3,786. 8. 6, and after allowing for reserve for plant and for liabilities outstanding, there was an unexpended balance of £900 at 31st December, 1938.

APPOINTMENT OF STAFF IN CEYLON AND MALAYA

At the request of the Board of Management steps were taken to select candidates to fill the vacant posts of Geneticist and Soils Chemist. Arrangements were made by the Committee for the officers appointed to these posts, Dr. C. E. Ford and Dr. L. A. Whelan, to receive special study courses at the Rothamstead Experiment Station before proceeding to Ceylon.

Mr. V. H. Wentworth, who was appointed by the Rubber Research Institute on the recommendation of the Committee to fill the vacant post of Assistant Chemist in Malaya received preliminary training for one month in the laboratories of the Imperial Institute.

CO-OPERATION WITH OTHER ORGANISATIONS

The year under review has seen a considerable extension of research activities financed by rubber-producing interests through the three National research units formed under the aegis of the International Rubber Regulations Committee, viz., the British Rubber Producers' Research Association (London); the Rubber Stitching (Amsterdam) and the Institut Francais du Caoutchouc (Paris).

The London Advisory Committee has had under consideration appropriate measures to extend their liaison activities so as to extend and strengthen the co-operation between the research institutes in the East whose main function is that of production research and the afore-mentioned National units who are charged to conduct consumption research. Details of the measures were left in abeyance pending the arrival in England of the Director of the Rubber Research

Institute, Malaya, but it is anticipated that the London Advisory Committee will be able to contribute Internationally towards the general co-ordination of rubber research.

In order that the staff in London should be familiar with practical conditions of rubber preparation on the plantations and become better acquainted with the research in regard thereto carried out in the East, arrangements were made by the Committee for Mr. W. S. Davey to make an extensive tour of Malaya, Ceylon, and the Netherlands East Indies.

Mr. Martin, Superintendent of Rubber Investigations, continued to serve as a representative of the R.A.B.R.M. on the Joint Committee of that Association and of the British Electrical Research Association, dealing with the quality of ebonite. He also represented the Rubber Growers' Association, on the Committees of the British Standards Institution appointed with a view to co-ordinating methods of testing rubber and latex, where he served as Chairman of the Latex Panel.

Conferences between Mr. Martin and Dr. van Rossem, Director of Research of Rubber Stitching, were held in the Research Laboratories at Delft and at the Imperial Institute, at which matters of common interest were discussed.

At the request of the British Rubber Producers' Research Association, Mr. Martin visited the Sisal Research Station at the Linen Research Institute at Lambeg to report on various proposals for the application of rubber to Sisal.

Mr. Martin represented both the Committee and Rubber Research Institute, Malaya, at the International Rubber Technology Conference in London. He also acted as general reporter to the section of the Conference dealing with plantation subjects. Mr. H. C. Baker submitted a paper on the preparation and properties of halogen derivatives of rubber from latex. A large party from the Conference accepted the invitation to visit the rubber research laboratories, exhibition galleries and cinema at the Imperial Institute where they were entertained to tea by the Institute and the Committee.

STANDARDISATION OF RAW RUBBER

As stated in the Report for 1937 a Sub-Committee was appointed last year to deal with this subject in view of the complaints received from manufacturers concerning the difficulties experienced by some of them in obtaining uniform supplies of raw rubber suitable for their requirements.

During a discussion with the Director of the Rubber Research Institute, Malaya, on the request made by the Sub-Committee for a comprehensive programme of research to be undertaken in the East he suggested that it would be desirable first to obtain a definite statement as to the requirements of consumers of different types of rubber.

The report received on an enquiry circulated by the R.A.B.R.M. indicated that there was practical unanimity among its members as to the desirability of a standard product and there was general agreement as to the properties in which

improvement is necessary, viz., normally the rubber should be free from mechanical impurities and mould ; it should be of uniform softness (two grades, one soft, and the other hard, but both uniform might be advantageous) ; the rate of vulcanisation should be uniform and the ageing should be good.

The representatives of manufacturers on the Sub-Committee also pointed out that the range of variation in quality of first grade rubber is at present extremely wide, *e.g.*, it is possible to find rubber which will be badly undervulcanised under standard conditions whereas other rubber will vulcanise so rapidly as to "set up" on the mixing rolls.

The above views were confirmed in general by the Crude Rubber Committee and the Rubber Division of the American Chemical Society ; also American and British manufacturers pointed out that with the unavoidable use of rubber showing wide variation in quality, consumers have experienced a desire for rubber approximating as closely as possible to their individual convenience and this has led to different opinions regarding the desired standard of quality of rubber. A uniform grade of rubber could and would be adapted (by the main consumers at least) in a standardised routine manner by appropriate processing and compounding.

It was considered by the Sub-Committee that in the first instance steps should be taken to determine the procedure to be adopted for fixing the tolerances to be allowed for a standard rubber and it was agreed that in view of the complexity of the problem work should be concentrated initially on vulcanisation properties and on liability to scorch. A preliminary specification dealing with these problems was submitted by the representatives of manufacturers and arrangements made for the staffs of the Committee and of the R.A.B.R.M. to co-operate in the preparation of detailed methods of testing.

The Sub-Committee were impressed by the statement made to them by manufacturers that about 10 per cent. of first grade plantation rubber contained sand in such quantity as to make it unsuitable for use in tube manufacture and the possibility of preparing a scheme for the identification, by an official mark, of rubber from estates adopting agreed standards of cleanliness was under examination at the close of the year.

INVESTIGATIONS

The development of tests for determining the quality of latex again formed an important feature of the work. In the experimental investigations special attention was devoted to an examination of the results given by the methods advocated by different laboratories, which, although similar in principle, varied in detail, and gave slightly different results, particularly as regards the determination of the dry rubber content of latex. As a result of subsequent discussions with research and trade organisations interested in the subject, a definite procedure was agreed for inclusion in the draft specification for latex testing which is being prepared by the British Standards Institution.

The long-range investigation commenced last year of the colloidal properties of latex, was continued and was concerned with determining the lines

of attack most likely to give fundamental information concerning the phenomena which occur in the preparation and utilisation of latex. It was decided to concentrate in the first instance on the examination of the distribution of non-rubber substances in latex, *i.e.* the amounts dispersed in water and the amounts on the surface and inside the rubber globule, together with the effect on this distribution of the addition of various substances to the latex. Some difficulty was experienced in obtaining accurate results by the method of investigation proposed, but this was mostly overcome by the end of the year. The work is being continued.

A new development during the year in the investigations of dry rubber was the study commenced of the resistance to abrasion of raw rubber when vulcanised in a tyre-tread mix. This investigation was prompted by the widely published claims for the superiority in this respect of tyre-treads made from synthetic materials. Progress in this investigation is somewhat hampered by the lack of a generally accepted reliable laboratory test for abrasion, but a method of test has now been approved by the Committee and is being used to study different types of raw rubber.

The grants made in previous years by the Technical Research Committee of the Rubber Growers' Association for the investigations into the use of latex cement mixtures for flooring and for the incorporation of rubber in bitumen for highway surfacing, were continued by the British Rubber Producers' Research Association on taking over the work of that Committee. Since its inception in 1935 the work on the application of latex to flooring has been principally concerned with mixtures of latex and aluminous cement. These investigations have established the principles involved in designing mixtures and have given firms who are interested in the subject, some of whom have had little previous experience with rubber, a basis for practical development.

Attention has recently been concentrated on the possibility of devising superior mixtures without aluminous cement but using materials giving a mixture setting within a few days, with a view to obtaining improved properties as regards reliability, colour, texture and mechanical properties. The results so far obtained are promising.

In addition the development of physical tests has been continued with a view to the production of a quality specification. Owing to the novel properties of latex cement mixtures and the absence of recognized tests, the work will take some time to complete.

The laboratory investigations on the effect of rubber on the properties of bitumen were continued and, in addition, three highway surfacing trials were made with different types of mixtures including one containing a high proportion of rubber. This mixture was particularly interesting because it was the first section of a continuous carpet coat of a definitely rubbery nature so far laid in this country. Unfortunately this mixture is not sufficiently cohesive and it is probable that a larger quantity of bitumen or a softer grade than that employed is desirable.

As in previous years, the staff in London co-operated with the chemists in the East in the examination of samples prepared in connection with experiments in Ceylon and Malaya. A list of the reports furnished on these investigations and on others initiated in the Committee's laboratories is given below. Further information as to the investigations completed and in progress during 1938 will be found in the technical appendix to this report.

REPORTS ON INVESTIGATIONS FORWARDED TO CEYLON AND MALAYA DURING 1938

Latex

Testing.—Latex testing :—

- (1) Extraneous matter.
- (2) Tensile strength of dried latex films.

Notes on the sampling of latex.

Sampling of latex.

Colloidal Properties.—Colloidal phenomena associated with creaming.

Investigations on the colloidal properties of latex.

Colloidal properties of latex :—

- (a) Distribution of nitrogen.
- (b) Studies in repeated creaming.

Storage.—Storage of latices containing different amounts of ammonia.

Effect of storage on the properties of latex :—

- (a) Latex from Ceylon.
- (b) Latex from Malaya preserved with amounts of ammonia.

Concentration.—Latex creamed with Konniyaku meal.

Concentration of latex by evaporation.

Preservation.—Special types of latex.

Examination of miscellaneous samples of latex.

Chemical Derivatives.—Bromination of latex.

Dry Rubber

Properties of rubber of importance in connection with competition from synthetic products :—

- (a) Development of a suitable abrasion test.
- (b) Effect of conditions of storage and accessory substances on the properties of rubber.

Purified rubber from Java.

Smoked sheet from Indo-China.

Chlorinated and brominated derivatives of rubber from latex.

Patents

In conjunction with the British Rubber Producers' Research Association, steps were taken to obtain English patents in connection with the inventions arising out of the work of the staffs in London and the East. As in previous years, the R.R.I., Malaya and the R.R.S., Ceylon were supplied with copies of specifications in respect of inventions relating to processes for the preparation or utilisation of raw rubber and latex likely to be of interest to them.

Specifications Sealed During 1938

- 474651 Concentration of latex by Creaming (communicated by the Rubber Research Institute of Malaya)
- 476073 Stabilised Cream (communicated by the R.R.I., Malaya)
- 476269 Brominated Rubber
- 476743 Preparation of Chlorinated Rubber
- 484712 Rubber and Cement Mixtures

Other Patents in Force at December 31st, 1938

- 395774 Soft Rubber
- 395775 Rubber Crumb
- 396880 Rubber Crumb
- 428100 Rubber and Road Tar Mixtures
- 433303 Concentration of Latex—Surface Process
- 430935 Creaming Latex with Seed Gum
- 450222 Hemi-Cellulose Creaming Agent
- 465226 Organic Liquid Addition to Latex
- 415133 Organic Colloidal Addition to latex.

(Signed) P. J. BURGESS,
Chairman.

„ J. A. NELSON,
Secretary.

Imperial Institute,
27th July, 1939.

LONDON ADVISORY COMMITTEE FOR RUBBER RESEARCH (CEYLON AND MALAYA).

TECHNICAL APPENDIX TO REPORT FOR 1938.

LATEX

Specification and Testing.—In the Technical Appendix to the Report for 1937 reference was made to the interest displayed by the Crude Rubber Committee of the U.S.A. and the British Standards Institution (representing growers, manufacturers and trade organisations) in the formulation of a specification for latex. During the year special attention has been given to the problems arising from criticisms of some of the tests recommended by the British Standards Institution. These problems have been chiefly concerned with methods of sampling, determination of dry rubber content and the evaluation of colour (greyness).

Sampling.—Experience gained in the routine testing of latex has shown that the lack of a standardised method of sampling sometimes leads to the collection of unrepresentative samples, *e.g.*, a sample of creamed latex was found to have a dry rubber content of approximately 26 per cent. and obviously was not a representative sample, since on standing it separated into two layers, a cream and skim, and further samples subsequently obtained from the same consignment had a dry rubber content of over 50 per cent.

The method of sampling at present recommended by the British Standards Institution involves a considerable expenditure of time and energy in rolling, shaking and stirring in order to obtain a uniform dispersion, and the work is generally carried out at the Docks under non-technical supervision.

Efforts have accordingly been made to find a simpler and more reliable method of sampling, and in this connection experiments have been carried out, in co-operation with representatives of the rubber trade, using a sampling tube similar to that described by Georgi, (*Malayan Agric. Journal*, 1937, XXV, p. 461, see also Murphy Proc. Rubber Technology Conference, 1938, p. 151) for the sampling of palm oil. It consists of an iron tube about $1\frac{1}{2}$ ins. diameter and of sufficient length to reach the bottom of a 50-gallon drum. The base of the tube consists of a weight attached to an iron cable by which the bottom of the tube may be opened or closed as required. Owing to the space occupied by the base, the tube does not sample the lowest layer of latex, but its use was found to reduce considerably the liability to a large error in sampling. The results given by concentrated latices were not so reliable as those given by 38-40 per cent. latex and in both cases stirring was still necessary to ensure reliability.

A modified sampling tube of stainless steel was, therefore, designed having a conical orifice in the base which can be sealed by means of a stainless steel ball attached to a rod. The end is detachable enabling the tube to be cleaned easily

after each sample is drawn and, as the bottom plate is comparatively thin, latex down to 1/16 in. from the bottom of the drum is included in the sample. Experience with this tube has shown that whilst it is still necessary to stir the latex to some extent, the amount of stirring required is reduced, and its use does eliminate the possibility of obtaining totally unrepresentative samples.

Determination of Dry Rubber Content.—The details of the method of determining dry rubber content tentatively put forward for criticism by the British Standards Institution were considered to be satisfactory because the determination could be carried out without expensive equipment (*e.g.*, crepeing rolls) and because the detailed procedure agreed upon is a compromise between the extremes of the differences between different laboratories. The detailed method has now been criticised because (*a*) the values obtained represent a figure which is in excess of the caoutchouc hydrocarbon in latex by an amount equal to the non-rubber substances in the washed and sheeted coagulum, and although the pure hydrocarbon content of latex is an ideal which is difficult to obtain, an improvement in this direction might be obtained by greater dilution of the latex and the addition of a more dilute coagulant; (*b*) the conditions of the determination do not always lead to the complete coagulation of the latex in the form of a coherent clot, and there is frequently a milky serum which represents a loss of rubber particularly in the case of centrifuged latex when tested in the East soon after preparation. These two criticisms are to a certain extent self-contradictory, because the greater the dilution of the latex the more difficult it is to obtain a coherent clot. Experiments were carried out in co-operation with other laboratories in Great Britain and it was found that the British Standards Institution method did not always yield a completely clear serum and that better coagulation was obtained with less dilution of the latex and stronger acid. Experiments were also carried out by the Rubber Research Institute, Malaya, who confirmed that the British Standards Institution method gave milky serum with freshly-prepared centrifuged latex, but was satisfactory for other types of latex. Further dilution of the latex gave a less coherent clot. As a consequence of these experiments the British Standards Institution decided to restrict its method of determining dry rubber content to 38 to 40 per cent. ammonia-preserved latex, and has not so far formulated a method of determining the dry rubber content of concentrated latex.

On the recommendation of one organisation experiments were made with sulphuric acid as a coagulant. The results obtained in London and in Malaya were higher than those given by acetic acid, and it was difficult to account for the difference merely by assuming more complete coagulation. The method at present preferred by the staff is one using somewhat stronger acetic acid than that at present recommended in the British Standards Institution method, but further experience is necessary with all types of latex before making a definite recommendation.

In order to obtain data as to the reliability of the determination of dry rubber content by the methods now employed in different laboratories a series of six

samples were prepared by the Rubber Research Institute of Malaya and submitted by the Committee to various laboratories in America, Great Britain and the East with a view to obtaining information as the tolerances which may be expected. Murphy (Proc. Rubber Technology Conference, 1938, p. 151) has suggested tolerances of ± 0.15 per cent., a figure which is considered to be excessive by the trade. The results obtained in the different laboratories were observed to be in fairly good agreement, but an analysis of the variation indicated that the tolerance suggested by Murphy is not too wide.

Colour of Latex.—In the previous report (1937) it was stated that the colour standards for matching latex had been brought to the notice of the British Standards Institution and the Rubber Trade Association, and that it was anticipated that these standards would become available at a low cost, if reproduced in the form of cellulose colour cards.

The colour card consisting of nine shades has been used tentatively by the Rubber Trade Association and has been found useful in settling disputes, but the colour of latex is now generally satisfactory and the number of cases requiring arbitration is very small. The British Standards Institution has also adopted a modified form of colour card, at the same time pointing out that it is necessary to use a colorimeter for the accurate measurement of colour. During the year an opportunity occurred of measuring colours of a number of latices with an inexpensive colorimeter of the photoelectric cell type (Bolton and Williams), and the apparatus appeared to be suitable for the purpose. With the aid of the colour cards there should be little difficulty in making a rough classification of the colour of latex on estates, at the Docks and by the trade, and if further refinement is required, laboratory tests can be carried out with a colorimeter to determine how the colour of a sample compares with known standards.

Quality.—The main object of the latex investigations carried out in London is to maintain and improve, in co-operation with the research organisations in the East, the quality of preserved and concentrated latex. The examination of samples prepared in the East by different treatments and under different conditions is only of value in so far as there are available suitable tests to determine important differences in quality. The usual routine tests involve chiefly the determination of the broad outline of the chemical composition of different latex samples, *e.g.*, dry rubber content, ammonia, foreign matter, etc. These tests are of importance, but they fail to indicate whether a sample which is not obviously defective is more suitable for any purpose than another of similar composition. Not only is it necessary to determine the amount of rubber, ammonia, coagulum, foreign matter, etc., in a latex, but it is even more important to know how the physical properties of different latices are modified by stabilisers, compounding ingredients and coagulants. The interpretation of differences in physical properties in terms of industrial technique is not easy but is likely to improve with experience. The chief difficulty, however, with regard to the determination of the quality of latex is that although physical properties can be determined for a given set of conditions the information obtained is usually specific to these

conditions. The results may be misleading if the conclusions drawn are applied to different combinations of stabiliser, compounding ingredients and coagulants. It is, therefore, necessary to seek tests of a general and fundamental character in order to evaluate the quality of latex.

In previous years attention was given to the development of a zinc oxide-stirring stability test which has proved useful, but while the test distinguishes between latices containing different amounts of natural stabilising agents it fails to indicate how these latices are likely to behave when subsequently treated by manufacturers with various stabilising and other ingredients. In addition it is now known that a low stability according to this test may be associated with a high stability under industrial conditions, *e.g.*, purified latex and latex preserved with sodium pentachlorophenate are unstable according to the test, but give better results than normal latex under many industrial conditions. In spite of these deficiencies the test is being used in the Committee's laboratories for the routine examination of the quality of latex until a better one is available, because it has been found useful by some users of latex and indicates differences in quality not determined by other means. The conclusions drawn from the test are limited, however, to differences in stability under the conditions of the test used without specifying whether the differences would in general be favourable or otherwise.

Attempts have been made by some manufacturers to devise other tests for the quality of latex, and particulars of two new tests were published during the year (Proc. Rubber Technology Conference, 1938, pp. 111 and 151) and these tests are being studied in the laboratories. Enquiries have indicated that there is a difference of opinion regarding their merits, and in any case they only give partial information regarding quality, and should be supplemented by other tests.

In order to devise fundamental tests for the quality of latex it is considered necessary to study (1) the rubber globules, (2) the aqueous serum, and (3) the boundary surface between the globules and the serum. As far as possible these three phases are receiving individual attention, but since they are partly inter-related, it is generally necessary to study combinations of phases and to estimate indirectly the functions of each. The rubber globules vary in size and contain not only caoutchouc which may vary in quality and affect the usefulness of the latex, but also non-rubber substances. The aqueous serum contains non-rubber substances which can react with compounding ingredients and cause profound changes in the properties of latex as well as in the vulcanising and ageing properties of the dry rubber. The boundary between the rubber globules and the serum is the seat of colloidal phenomena such as stability, coagulation, viscosity, etc.

The investigations so far carried out are in their preliminary stages and do not completely cover the range of subjects which it is desired to investigate. Principal attention has been given to devising a direct method of studying the chemistry of the boundary of the rubber globules and aqueous serum, by determining the distribution of non-rubber substances between the rubber globules

and the aqueous serum. The method devised is probably not so useful as a routine test for the quality of latex as for studying chemical changes at the surface of rubber globules. Information on the subject may lead to and must in any case precede the development of a sound routine test for quality.

The second approach has been through a study of the properties of dried latex films with a view to obtaining information concerning differences in the caoutchouc and the effect of serum substances. As explained in last year's report there are objections to the use of this method as a routine test for quality but the investigation has shown that the caoutchouc in ammoniated latex differs in quality from that in fresh latex and that there is an important relation between serum substances and caoutchouc markedly affecting the mechanical properties of the rubber. The investigation indicates that it may be desirable to institute control tests, but much further information is required before attempting to devise a test of this nature.

The third method has consisted in a study of creaming chiefly because it is a colloidal phenomenon, easily studied, which should bear some relation to boundary conditions and the nature of the serum substances. All these investigations have yielded important information, but whereas the first two are likely to become more important as they proceed, the study of creaming phenomena indicates that variations are likely to be correlated with viscosity which, if necessary, could be studied more directly. Details of the investigations are as follows :—

Distribution of Non-Rubber Substances in Latex.—It is generally accepted that the rubber globules in latex are surrounded by a protein sheath which largely determines the colloidal behaviour of the latex. Whether other substances such as lipins are also involved is not so well known. Experiments were carried out to determine the relation between the concentration of non-rubber substances in the aqueous serum phase of latex and on the rubber globule, attention being given chiefly to the nitrogen distribution.

The methods used involve the separation of latex into two fractions containing different concentrations of rubber. From the amount of non-rubber substance present in each fraction the amount present in the aqueous serum and that associated with the rubber can be calculated. Three methods of separation were tried, viz., (1) centrifuging, (2) filtering, and (3) creaming.

It was shown that the centrifuging method of separation gives unreliable results, and the discrepancies were ascribed to the fact that the smaller globules in the skim have a greater surface area per unit of weight than those in the cream and are, therefore, associated with more nitrogenous substances per unit of weight. In order to obtain reliable results it is necessary to obtain rubber-free serum, and experiments on prolonged centrifuging were in progress at the end of the year.

Both filtering and creaming have the advantage over centrifuging that they yield skim free from rubber. Experiments were carried out in which latex was

diluted and then filtered through battery jars or through Bechhold porcelain ultra-filters. Again irregular results were obtained for the amount of nitrogen associated with the rubber globules, and the values found were sometimes higher than the amount of nitrogen in coagulated rubber. The experiment showed that although a rubber-free serum could be obtained, a thin layer of reversible paste accumulated on the walls of the filtering medium and this paste appeared to hinder the passage of some of the nitrogenous material.

The determination of the amount of nitrogen associated with the rubber globules by separating latex into two fractions by the addition of creaming agents has the disadvantage that the equilibrium of non-rubber substances may be disturbed by the creaming agent, but information on this point is being obtained by comparing the results of creaming experiments with those given by prolonged centrifuging. In the meantime experiments were carried out in which a range of dilutions of latex was creamed with methyl cellulose and the non-rubber substance distribution determined. The results were not wholly satisfactory as methyl cellulose required the presence of a surface-active material for efficient creaming. Latex contains naturally-occurring surface-active materials, but on dilution these were insufficient for a clear separation of cream and rubber-free skim. There was evidence, however, that reliable values could be obtained for the control of non-rubber substances associated with the rubber in 40 per cent. latex and that dilution did not markedly reduce the amount of nitrogen, acetone-soluble material and fatty acids associated with the rubber.

As sodium alginate is a creaming agent, which can be obtained in a reasonably pure condition free from nitrogen, and as it does not require the assistance of a surface-active material, the investigation was continued with this creaming agent, the creaming process being repeated ten times so as to obtain a much greater dilution of the serum substances than in the previous experiment.

The results showed that the amount of nitrogen associated with the rubber in the case of this sample of latex was dependent upon the dilution of the latex in accordance with the following law $(N_r) = 0.128 (N_s) 0.056$ where (N_r) is the concentration of nitrogen in and on the rubber globules and (N_s) is the concentration of nitrogen in the serum. The amount of nitrogen associated with the rubber globules of the original latex was shown to be 0.17 per cent., and after creaming ten times, which was equivalent to diluting the serum 1,000 times the concentration was 0.13 per cent. The crepe obtained from the latex which had been creamed ten times contained 0.12 per cent. nitrogen. The dry rubber content of the purified latex was 45.24 per cent. and the total solid content 45.39 per cent.

It is interesting that these preliminary data indicate that dilution of the latex has only a small effect on the amount of nitrogen associated with the rubber globules. Other investigations using glycol cellulose as a creaming agent have shown that the fixed nitrogen can be reduced by treatment with alkalies, enzymes, etc., and the investigations are being continued in order to study more thoroughly the chemistry of alterations on the surface of the rubber globules produced by different treatments.

Properties of Dried Films.—The tensile strength of dried latex films has been used by some organisations as a test for determining the quality of latex, but as indicated in last year's report the values obtained are markedly dependent upon the period during which the films are stored in a dry atmosphere. Investigation of the subject has, however, been continued and extended because the results indicated the possibility of a chemical change in the caoutchouc, and because the effect of various factors on the tensile strength of dried films is of technical importance, and it is desirable to understand the principles involved in the formation of strong and weak films.

For this purpose dried latex films from ammonia-preserved latex and from the same latex after purification by creaming four times were stored in (1) air, (2) oxygen, and (3) nitrogen over sulphuric acid and over saturated aqueous solution of potassium chloride and then submitted to tensile strength, plasticity and solubility tests. The latter was included because of the possibility of a sol-gel transformation in the rubber which would account for any changes in tensile strength observed. After keeping for five months there was little difference in properties due to the effect of storing in either air, oxygen or nitrogen, but samples kept dry were stronger, less plastic and less soluble than those kept in a moist atmosphere, even though the latter were dried before testing. The most interesting feature of the results is that the "whole" latex samples kept in a dry condition were three times as strong as those from purified latex, and that the latter was the least soluble. There is, therefore, no direct relation between tensile strength and solubility. Further experiments have indicated that materials with colloidal properties similar to serum substances markedly improve the strength of dried latex films, and evidence has been obtained concerning fundamental principles governing the formation of strong and weak films, but there are gaps in the information obtained and publication is undesirable at this stage.

In order to determine solubility, experiments were made on the separation of sol and gel fractions by Pummerer's method (Ber. 1928, 61, 1583) using ethyl ether, but it was found more convenient to dissolve the rubber in a mixture of 100 parts of xylene and 20 parts of ethyl alcohol which gives low viscosity solutions and facilitates the separation and washing of the insoluble fraction by centrifuging. The method proved to be quick and accurate within 0.5 per cent., but the mixture is a better solvent for rubber than ethyl ether and the sol and gel fractions are not the same as those obtained by Pummerer. Whereas crepe from fresh latex was completely soluble and sheet almost completely soluble, crepe and dried films from ammonia-preserved latex contained over 20 per cent. insoluble rubber and in special circumstances over 40 per cent. It is an obvious conclusion that the treatment of latex with ammonia has an important effect on the caoutchouc phase (c.f. Roberts J.R.I., 8, 2, 1938, 196). It is unlikely that ammonia in the concentration employed in preserved latex produces the maximum effect on caoutchouc or that it is the only substance to have an effect. The investigation is, therefore, being continued.

Creaming Phenomena.—It was shown last year that creaming agents cause a reversible clustering of rubber globules which, on account of their size,

rise more quickly towards the surface of the latex. The clustering effect is brought about by small concentrations of the creaming agent and is not markedly enhanced by higher concentrations. An obviously important factor in creaming is the viscosity of the aqueous serum which tends to retard the upward drift of the clusters. As all creaming agents form viscous solutions at low concentrations and the viscosity of the solution increases rapidly with concentration, it is obvious that there is an optimum concentration of creaming agent beyond which the increase in viscosity is more effective in retarding creaming than is the small increase in clustering in promoting creaming. In order to study the effect of viscosity on creaming, experiments were carried out with sodium alginate which has the advantage of being marketed in grades differing only in viscosity. It was found that the efficiency of creaming as measured by the relative amounts of rubber in the upper and lower layers, is a function of the viscosity of the underlayer, and does not depend upon the grade of creaming agent. Since the viscosity of the underlayer is an inverse function of the concentration of the creaming agent, it is obvious that less of the more viscous grade is required to produce a particular degree of separation. The results also show that creams with the highest dry rubber content are obtained at relatively low viscosities of the underlayer, the amount of creaming agent being insufficient to yield a skim free from rubber. Addition of more creaming agents enables a rubber-free skim to be obtained but the increase in viscosity retards the upward drift of rubber globules and consequently a cream with a lower dry rubber content is obtained in a normal period. Experiments were carried out with several other creaming agents, differing in chemical constitution and viscosity, and the results also indicated that there is an optimum viscosity above and below which normal creaming agents are not so efficient. The results are not sufficiently extensive to draw definite conclusions, but it appears likely that an important control test on any creaming agent which may vary in quality is to determine the viscosity of its aqueous solution and then to make an adjustment in the amount added to latex according to whether its viscosity is below or above the fixed standard.

Experience gained with methyl cellulose in the purification of ammonia-preserved latex by repeated creaming showed that this substance was exceptional in requiring the presence of surface-active materials (Twiss and Carpenter Proc. Rubber Tech. Conference, 1938). When latex which had been purified by creaming five times was treated with methyl cellulose, no clustering could be observed and the latex did not cream. Further experiments showed that both kationic and anionic soaps promoted clustering and, therefore, creaming with methyl cellulose in purified latex, and that the effect was independent of the pH of the latex over the range 3 to 12. It is remarkable that although methyl cellulose requires a surface-active material to cause clustering and creaming, neither the chemical nature of the rubber globule nor the sign of the electric charge appears to be important.

The possibility has been considered that all creaming agents require a surface-active material and that some of the creaming agents used are efficient with

purified latex because they are of vegetable origin and are not necessarily pure substances but possibly mixtures of surface-active material and clustering agent, but it was found that an ammonium salt of a high molecular polycarboxylic acid and sodium alginate were both able to cluster and cream purified latex in which methyl cellulose was inactive. It is evident, therefore, that additional surface-active materials are not essential to all creaming agents. The work on the mechanism of creaming is now being discontinued except in so far as it is related to other work on the chemistry of the surface of rubber globules.

Keeping Properties.—No comprehensive study has yet been made of changes in the properties of preserved and concentrated latex on keeping and such an investigation cannot be carried out satisfactorily until methods of determining quality are available. Reference was made last year to the decrease in stability on keeping as determined by the zinc oxide-stirring test, and it has now been confirmed that according to this test preserved field latex with a high stability when first received in London becomes less stable after 12 months. The same latex concentrated by creaming is less stable than the unconcentrated latex on arrival in London, but after keeping 12 months the difference between the two is small. Evidence was also obtained that the 40 per cent. latex has less nitrogen associated with the rubber globules after keeping and that the creamed latex shows little change, suggesting that the protein sheath around the rubber globules in normal latex is slowly hydrolysed by ammonia, but that the creaming agent has hindered this reaction in the concentrated latex. It is not known whether these changes are specific to these samples or whether they represent a characteristic difference between creamed and normal latex. It is evident that the changes which occur are complex and require detailed study before drawing conclusions.

There is a slight tendency for the rubber content to decrease, presumably due to the formation of a few minute clots of coagulum when the latex comes into contact with both air and the container. There is, however, no obvious change in ammonia content. The investigation is being continued as opportunity occurs, but as explained above it is probably premature to arrange a systematic and comprehensive study at this stage.

DRY RUBBER

Standard Rubber.—In view of the representations of manufacturers, the Committee decided that special attention should be given to the preparation of uniform rubber on estates. This decision has raised a number of technical problems requiring action in the East and in London. The chief technical problems now being dealt with in London in this connection are (1) the formulation of standard methods of testing in co-operation with European and American manufacturers, (2) the critical consideration of standards of uniformity suggested by manufacturers, and (3) the carrying out of comparative tests in order to ensure that the same results can be obtained in different laboratories when testing duplicate samples.

At the end of the year the methods of testing to be employed had been outlined by manufacturers, and in co-operation with the Research Association of British Rubber Manufacturers, the staff had prepared a detailed specification. It will, however, probably require considerable revision before it receives wide circulation.

Criticisms of the proposed standards of uniformity have been received from the East, but no action has yet been taken because these standards must depend upon the methods of testing which are not yet fully approved, and it is necessary to accumulate as much data as possible using these specific methods before final decisions can be made regarding the standards of uniformity.

In the meantime tests have been carried out in co-operation with a manufacturer who supplied 12 samples with a range of properties beyond the limits of the provisional standards. Parallel results were obtained in the two laboratories, but there were regular differences which would affect the classification of the samples. Further work is in progress in co-operation with the Research Association of British Rubber Manufacturers in order to determine causes of differences and to ensure, if possible, that two different laboratories carrying out the methods of test prescribed can obtain the same results within a reasonable and known margin of error.

Abrasion Resistance.—The claim is made that some of the synthetic rubber-like materials are more resistant to abrasion than natural rubber and that tyres made of these new materials have a longer life than those hitherto manufactured. The relation between resistance to abrasion and chemical constitution is not known, but evidence continues to accumulate that the rubber hydrocarbon is not a material of fixed chemical constitution and that materials and conditions, which were previously regarded as inert, produce changes. Since some synthetic materials are apparently more resistant to abrasion than rubber, modifications of the chemical structure of rubber without destroying its normal mechanical and vulcanising properties may have some effect on its resistance to abrasion. Moreover, resistance to abrasion is markedly dependent upon the intimate relation between carbon black and rubber. This relationship is not fully understood, but there is sufficient information to indicate that alterations in the serum substances or in the rubber hydrocarbon may affect this relationship. Some rubber manufacturers consider that they have definite evidence of variation in resistance to abrasion due to variation in the rubber.

Taking these factors into account, there is a reasonable possibility that a systematic study of the problem may indicate methods of improving the resistance to abrasion of natural rubber. The chief difficulty is that abrasion tests are complicated and the results are not always consistent with those given in service.

After consultation with manufacturers it was decided to commence experiments using an Akron Standard Mould abrasion machine and a carbon black-rubber mix similar to those employed in tyre treads. These mixes are sometimes described as "sticky," the abraded particles clinging to the surface and

affecting the results of abrasion tests. In preliminary experiments it was found that some samples of rubber prepared in the East by special methods were markedly superior to normal estate sheet, and manufacturers suggested that this result might be due to the stickiness of the mixture. Experiments have, therefore, been carried out to eliminate the possibility of misleading results due to this cause. The apparatus is now supplied with a grit feed which supplies carborundum powder between the sample and the abrasion wheel. More regular results are obtained, but the test is not yet regarded as wholly satisfactory and the investigation is being continued.

Halogen Derivatives of Rubber from Latex.—A study has been made of the halogenation (chlorination and bromination) of rubber in latex because (1) fully chlorinated rubber prepared from rubber dispersed in an organic solvent is of technical importance and it may be possible to manufacture a cheaper or better product from latex, and (2) the modification of rubber by partial halogenation, without destroying completely vulcanising and elastic properties, may render it more suitable for special purposes. The investigation initiated in London and described in last year's report was continued by the Rubber Research Institute in Malaya, using fresh latex and the samples prepared were examined in London. The more heavily chlorinated samples were almost resinous and appeared to deteriorate on keeping, but those containing anti-oxidants still retained elastic properties. The brominated samples were superior to those containing chlorine. On vulcanisation the samples were inferior to standard rubber, but were more resistant to the swelling action of solvents. On the other hand, they became very tender on immersion in solvents. The samples yielded ebonite with a higher softening point than that of ebonite from standard rubber, but the improvement in this direction was offset by an increase in brittleness. It was considered that the samples had no commercial value.

It was found that rubber in latex could not be chlorinated to the same degree as rubber in solution, but that in some circumstances chlorinated rubber in the form of a white powder very soluble in organic solvents could be obtained by keeping the temperature of the reaction below 50° C. The investigation is now being continued in the East with a view to determining whether a product with commercial applications can be obtained by the chlorination of fresh latex.

A study was made of the chemistry of the reaction between bromine and rubber in dilute latex by determining the amount of bromine which combined with the rubber and the amount of hydrobromic acid liberated and then calculating the amount added and substituted per isoprene unit. It was found that substitution and addition occurred simultaneously and that the addition was succeeded by cyclisation with the liberation of hydrobromic acid, the phenomenon being accelerated by factors (such as temperature and concentration of bromine) which increased the rate of reaction. As cyclisation represents a modification of rubber structure which would be expected to reduce elasticity, further experiments are proposed to study the properties of halogenated rubber prepared under conditions in which cyclisation is reduced as much as possible.

APPLICATION OF LATEX TO ROAD OR FLOOR SURFACING

Since its inception in 1935 the investigation on the application of latex to flooring (and road surfacing) has been principally concerned with mixtures of latex and aluminous cement. During this period the manufacture of these materials has expanded considerably in Great Britain and interest in the subject is now being displayed in Australia and the U.S.A. The investigations carried out have established the principles involved in designing mixtures and have given firms, who are interested in the subject (some of whom have had little previous experience with rubber), a basis for practical development. Further improvements are chiefly a question of detail, and as this type of investigation is best carried out by firms who are intimately associated with the practical problems of the trade, no further work on latex-aluminous cement mixtures was carried out in this direction during the year except to give attention to two problems which are within the scope of useful work better carried out by a central organisation. One of the problems is concerned with methods of determining the quality of the finished product and has been referred to in previous reports and the other with the variability of latex.

In addition attention was given to the possibility of devising entirely new mixtures without aluminous cement, but utilising the information previously obtained concerning the relation between micro-structure and mechanical properties of latex-cement mixtures.

1. **Quality of Finished Product.**—As indicated in last year's report it is desirable to devise methods of determining the quality of the finished latex-cement mixtures. A sound specification would eventually be helpful to experienced manufacturers and would give potential users greater confidence in the new materials. Manufacturers may regard a quality specification as premature but the development of methods of test and the collection of data take several years. In continuation of previous work on compression, indentation, restitution and water absorption special attention was given this year to the accurate determination of tensile strength and of the adhesion of the mixtures to wood, cement, metal, tiles, etc. In both cases improved tests were devised.

2. **Latex Variation.**—Several firms in Great Britain have kept in touch with the Committee's investigations and conversations with technical staffs indicated that occasional difficulties are experienced owing to variability. An important part of this variation is due to the latex and an investigation was, therefore, commenced in which a study was made of the stability of compounded latex by several methods including the coagulation of the latex by aluminous cement. The investigation has not been carried sufficiently far to indicate a remedy for the difficulties experienced, but it has shown that the stability of some compounded latices changes considerably on keeping even for a few days, and that a useful purpose would be served by determining the types of mixtures which are least affected by time. Alkaline materials such as sodium silicate or caustic potash are found to be responsible for the most rapid changes in properties, and latex preserved with sodium pentachlorophenate instead of ammonia

appears to be the most stable to cement and the least affected by time. These investigations were still in progress at the end of the year.

3. **New Mixtures.**—Aluminous cement-latex mixtures are mechanically superior to those made with Portland cement and the principal structural difference appears to be that the former contains much more colloidal matter than the latter. Attention was, therefore, given to a study of the effect of colloidal compounding ingredients on latex, and an increase of 75 per cent. in the energy required to break dried latex films was obtained in some cases. Processes of obtaining improved toughened mixtures from latex were devised without using aluminous cement by keeping in mind the importance of developing a colloidal structure within the finished product. These mixtures appear to be suitable for flooring and other purposes, but the details require elaboration before the mixtures can be regarded as ready for commercial use.

(Sgd.) G. MARTIN,
Superintendent of Rubber
Investigations.

Imperial Institute,
London,
19th June, 1939.

(Sgd.) P. J. BURGESS,
Chairman.

AUDITOR-GENERAL'S REPORT FOR 1938.

The Chairman,
Board of Management,
Rubber Research Scheme,
Peradeniya.

Sir,

I have the honour to furnish my report on the audit of the accounts of the Rubber Research Scheme for the year 1938 and to forward the following documents duly certified :—

- (a) Dartonfield Estate Working Account for the year 1938.
- (b) Nivitigalakele Experiment Station Working Account for the year 1938.
- (c) Trading Account of Vulcanised Rubber Products for the year 1938.
- (d) Income and Expenditure Account for the year 1938.
- (e) Capital Account and General Balance Sheet as at December 31, 1938.
- (f) Statement of Receipts and Payments of the Officers' Provident Fund for 1938.

I. INCOME

2. The total income which accrued during the year amounted to Rs. 179,401. It fell below the estimate of Rs. 228,000 by Rs. 48,599 and the income of the previous year by Rs. 51,089.

3. The following is a comparison between the estimate and the actual income under the different accounts for the year under review :—

Account				Estimated	Actual	Excess	Shortfall
				Rs.	Rs.	Rs.	Rs.
1.	Cess Collections	...	...	207,900	149,431	—	58,469
2.	Interest	...	...	2,500	3,791	1,291	—
3.	Sale of Publications	...	...	400	818	418	—
4.	Profit from Dartonfield Estate	...	...	12,000	18,851	6,851	—
5.	Profit from Nivitigalakele Experiment Station	...	...	3,000	5,100	2,100	—
6.	Sundry Receipts	...	...	2,200	1,410	—	790
				228,000	179,401	10,660	59,259
Deduct Excess				...	...	...	10,660
Nett Shortfall				...	...	...	48,599

4. The reasons for the variations between the estimate and the actual income are as follows :—

Excess :

2. Due to under-estimate.

3. Due to under-estimate.

4 and 5. Due chiefly to the realisation of higher prices for rubber and coupons than anticipated.

Shortfall :

1. Due to reduced exports of rubber during the year.

2. Due to over-estimate of the receipts under General.

5. **Profit from Dartonfield Estate.**—The details of the expenditure incurred and the revenue earned from the Dartonfield Estate are set forth in the Working Account of the Estate. The profit earned for the year under review (Rs. 18,851) is below that earned for 1937 (Rs. 25,615) by Rs. 6,764.

6. **Profit from Nivitigalakele Experiment Station.**—The working of the Experiment Station for the year showed a profit of Rs. 5,100 as compared with the profit of Rs. 6,287 earned during the previous year. The details of the income earned and the expenditure incurred are set forth in the Experiment Station Working Account.

II. EXPENDITURE

7. **Revenue Expenditure.**—The total expenditure on Revenue Account exclusive of the amounts allowed for depreciation of fixed assets, the Passage and Audit Fee Reserves and the loss on the manufacture and sale of Vulcanised Products amounted to Rs. 142,720 as compared with Rs. 116,699 of the previous year. The details of this expenditure are fully set forth in the Income and Expenditure Account. The whole of this expenditure was checked with supporting vouchers and accounts.

8. **Capital Account.**—The expenditure incurred on fixed capital assets during the year amounted to Rs. 51,969. The details of this expenditure are as follows :—

	Rs.	cts.
Land including Development :—		
Dartonfield	2,827	06
Nivitigalakele	2,917	86
Buildings and Lines :—		
Dartonfield—Headquarters	19,421	55
Nivitigalakele—Headquarters	6,374	34
Furniture and Fixed Equipment :—		
Dartonfield	4,649	94
Nivitigalakele	291	25
Power and Water Supply :—		
Dartonfield	3,534	54
Nivitigalakele	4,657	28
Machinery and Tools :—		
Dartonfield	4,902	57
Laboratory Apparatus	2,392	29
	51,968	68

9. The following is a comparison between the original estimate and the expenditure incurred in respect of the year under review :—

Account	Estimated	Actual	Excess	Supple- mentary Saving Provision	
	Rs.	Rs.	Rs.	Rs.	Rs.
1. Administration of the Board :					
Travelling expenses of Members	1,750	1,751	1	—	—
2A-F. Personal Emoluments of					
Senior Scientific Staff ...	68,386	58,897	—	8,490	999
3A-E. Personal Emoluments of					
Junior Scientific Staff ...	4,883	2,948	—	802	1,083
4. Library and Publications :					
A. Library	1,000	1,172	172	169	—
B. Publications	1,200	1,850	650	800	—
5. Smallholdings Work :					
A. Salaries and Rent Allowances of Staff	14,438	14,012	—	—	426
B. Travelling and General Expenses	7,145	4,902	—	—	2,243
6. Laboratory :					
A. Equipment and Working Expenses	5,000	3,208	—	1,000	792
B. Furniture Replacements	50	15	—	—	35
7. Field and Factory Experi- ments :					
A. Field Experiments ...	4,235	3,812	—	26	449
B. Factory Experiments ...	1,636	1,266	—	150	220
C. Budding Instruction ...	1,132	1,096	—	—	36
8. Office :					
A-C Emoluments of Office Staff	8,121	8,142	21	26	—
D. Stationery and Office Equip- ment	2,000	1,951	—	—	49
E. Postages and Telegrams	1,700	1,873	173	—	—
F. Advertising	250	343	93	—	—
G. Telephones	1,150	390	—	—	760
H. Audit... ..	600	600	—	—	—

Account	Estimated	Actual	Excess	Supple- mentary Provision	Saving
	Rs.	Rs.	Rs.	Rs.	Rs.
9. Travelling Expenses of Staff	4,000	5,243	1,243	—	—
10. Maintenance of Buildings, Water and Power Supply :					
A. Laboratories and Offices	250	243	56	63	—
B. Bungalows	1,150	749	—	287	114
C. Water and Power Supply	350	638	376	88	—
11. Miscellaneous Items Shared with Estate :					
A. Dartonfield General Charges ...	5,416	5,145	—	50	221
B. Nivitigalakele General Charges ...	1,665	1,567	—	—	98
C. Upkeep of Roads and Grounds	405	472	67	—	—
D. Factory Upkeep	425	496	109	38	—
E. Power Supply	2,444	2,302	40	182	—
12. Contingencies :					
A. Contribution to London Advisory Committee ...	12,000	12,186	186	500	—
B. General Charges	750	673	—	—	77
C. Insurances	850	779	—	—	71
D. Staff Provident Fund ...	5,100	4,948	—	—	152
E. Passages	1,750	1,000	—	750	—
F. Entertainment Allowances	300	237	—	—	63
13. Depreciation	21,500	20,514	—	—	986
16. Capital Account :					
A. Senior Staff Bungalows (Dartonfield)	37,000	18,527	27	366 18,500	}
B. Water and Power Scheme	—	996	996	200	
C. Cart Road	—	191	191	753 185	
D. Factory Store and Tool Store	800	802	2	—	—

Account	Estimated	Actual	Excess	Supple-	Saving
				mentary Provision	
	Rs.	Rs.	Rs.	Rs.	Rs.
E. Field Laboratory for 'Geneticist (Nivitigalakele) ...	2,000	—	—	—	2,000
F. Junior Staff Bungalows (Nivitigalakele) ...	3,500	5,452	1,952	3,500	—
G. Apparatus for Soil Chemist	3,000	327	—	—	2,673
H. Botanical Laboratory Equipment ...	240	2,566	2,326	2,707	—
I. Book Cases for Library ...	450	450	—	—	—
J. Shelving for Record Room	300	300	—	—	—
K. Upkeep of Immature Areas (Dartonfield) ...	1,341	772	—	394	175
L. Planting 6 Acres (Dartonfield) ...	—	1,050	1,050	87 1,045	—
M. Replanting 13 Acres (Dartonfield) ...	—	551	551	613	
N. Immature Area Nivitigalakele ...	940	883	—	—	57
17A. Pinnagoda Budwood Nursery ...	—	985	985	890	—
B. Director's Bungalow (Dartonfield) ...	—	1,049	1,049	1,076	—
C. Smallholdings Propaganda Officer's Bungalow (Nivitigalakele) ...	—	3,608	3,608	3,798	—
D. Bungalow of Secretary to Director ...	—	796	796	800	—
E. Junior Staff Bungalows (Dartonfield) ...	—	3,603	3,603	4,000	—
F. Experimental Machinery (Dartonfield) ...	—	4,903	4,903	7,338	—
G. Bridge to No. 5 Field (Dartonfield) ...	—	229	229	130 110	—
H. Chief Clerk's Bungalow (Dartonfield) ...	—	50	50	250	
I. Nivitigalakele Cart Road ...	—	1,050	1,050	1,067	—
J. Nivitigalakele Water and Power Scheme ...	—	2,338	2,338	2,332	—

10. The reasons for the major variations between the estimate and the actual expenditure, as furnished by the Director of Research, are as follows :—

Savings :

- 2A-F Delay in appointment of Soil Chemist.
- 3A-E Analyst, Field Assistant and Peon not being appointed until 1939.
- 5A. Temporary vacancies in staff.
- 5B. Full programme not undertaken mainly owing to unavoidable delay in posting of Instructors to ranges.
- 6A. Over-estimate.
- 7A. Under-estimate of value of rubber from Wagolla.
- 7B. Over-estimate of requirements for upkeep of machinery.
- 7G. Over-estimate and adjustment of the amount of rental paid during the year in respect of 1939.
- 11A. Over-estimate.
- 13. Over-estimate.
- 16E. Postponement of expenditure.
- 16G. Payments not completed during the year.

Excesses :

- 4B. Increased expenditure on publications as provided for in the revised estimate passed by the Board.
- 9. Under-estimate and payment of Rs. 400 for travelling of officers and applicants for posts in England.
- 10C. Unanticipated expenditure on upkeep of pump, motor and transmission line.
- 16B. Extension of services to new bungalows.
- 16L. and M. Replanting of the 1935 Replanted area as approved by the Board.
- 17A. Fencing of multiplication nurseries as recommended by the Experimental Committee.
- 16H and 17A-J. Works sanctioned by the Board in 1937 not being completed during that year.

11. The excesses under the different items except the following have been sanctioned by the Board :—

1. Administration of the Board :	Rs.
Travelling expenses of Members *	1
4A. Library	3
8E. Postages and Telegrams	173
F. Advertising	93

								Rs.
9.	Travelling Expenses of Staff	...	...	...	...	...	...	1,243
10A.	Laboratories and Offices	...	...	...	...	...	...	56
	C. Water and Power Supply	...	...	...	...	...	...	376
11C.	Upkeep of Roads and Grounds	...	...	...	...	...	...	67
	D. Factory Upkeep	...	...	...	...	...	...	109
	E. Power Supply	...	...	...	...	...	...	40
16.	Capital Account :							
	B. Water and Power Scheme	...	...	...	...	...	...	43
	C. Cart Road	...	...	...	...	...	...	6
	D. Factory Store and Tool Store	...	...	...	...	...	...	2
17A.	Pinnagoda Budwood Nursery	...	...	...	...	...	...	95
	J. Nivitigalakele Water and Power Scheme	...	...	...	...	...	...	6

12. **Manufacture of Vulcanised Rubber.**—A Trading Account showing the cost of manufacture and the income from the sales of the Vulcanised Rubber Products is attached to this report. The undertaking has resulted in a net loss of Rs. 205 which is charged to the Revenue Expenditure for the year under review. The depreciation on the plant has not been charged to this account.

III. CAPITAL ACCOUNT

13. The cost of fixed assets at December 31st, 1937, stood at Rs. 619,158. The expenditure incurred on Capital Account during the year amounted to Rs. 51,969 bringing the value of the assets to Rs. 671,127 as on December 31st, 1938. The details of this amount are set forth in the Capital Account.

IV. BALANCE SHEET

(A) Liabilities

14. **Creditors—Rs. 10,442.**—Of this amount, a sum of Rs. 10,262 represents the total amount due to creditors for goods purchased or services rendered in respect of the year and Rs. 180, the subscriptions for 1939 publications, received in advance.

15. **Identification of Clones—Rs. 571.**—This amount represents the unexpended balance out of the recoveries from estates for expenditure on the identification of clones by two officers borrowed from the Rubber Research Institute of Malaya.

16. **Passage Fund Reserve—Rs. 3,614.**—During the year a sum of Rs. 2,983 was paid out from this fund to meet the cost of a passage to a member of the staff who went on furlough and the cost of passages provided to two new officers on their taking up first appointment under the Scheme. The contribution to the fund from the revenue of the year under review was Rs. 1,000 as compared with Rs. 1,250 during the previous year.

17. **Depreciation Reserve—Rs. 75,825.**—This sum represents the amount set apart for the depreciation of the fixed assets of the Scheme. The amount

transferred from revenue to this account during the year was Rs. 20,514 made up as follows :—

	Rs.	c.
Buildings and Lines :		
Dartonfield at 4% on Rs. 181,361·56	7,254	46
Nivitigalakele at 4% on Rs. 40,185·36	1,607	41
Furniture and Fixed Equipment :		
Dartonfield at 7½% on Rs. 22,726·83	1,704	51
Nivitigalakele at 7½% on Rs. 2,137·88	160	34
Power and Water Supply :		
Dortonfield at 7½% on Rs. 27,812,78	2,085	96
Nivitigalakele at 7½% on Rs. 583·58	43	77
Machinery and Tools :		
Dartonfield at 7½% on Rs. 73,564·59	5,517	34
Nivitigalakele at 7½% on Rs. 97·59	7	32
Laboratory Apparatus at 25% on Rs. 8,532·58	2,133	14
	20,514	25

18. **Provident Fund Reserve—Rs. 40,552.**—The particulars of the receipts and payments on this account are shown in the Provident Fund Account attached to this report. The balance standing to the credit of this fund at the beginning of the year was Rs. 31,091. The contributions by the staff during the year amounted to Rs. 4,536 and those made from the funds of the Scheme amounted to Rs. 4,948. Of the amount contributed by the Scheme a sum of Rs. 3,639 represents the bonus equivalent to the sum contributed by the staff during 1937 and Rs. 1,309 the interest due on the fund for 1938.

19. **Audit Fee Reserve—Rs. 604.**—This amount represents the balance of Rs. 4 out of the reserve for 1937 and Rs. 600 being the estimated cost of audit payable in respect of the year under review charged to the income of the year on the directions of the Board of Management. The actual cost of the audit for the year is Rs. 599·08.

20. **Surplus Account.—Rs. 133,307.**—This amount represents the accumulated cash surplus of the Scheme at December 31st, 1938. The cash surplus at the commencement of the year was Rs. 170,914. The excess of income over expenditure for the year was Rs. 14,362. The net capital expenditure incurred during the year was Rs. 51,969. There was, therefore, a cash deficit for the year amounting to Rs. 37,607, which reduced the total cash surplus at the close of the year to Rs. 133,307.

(b) Assets.

21. **Debtors—Rs. 15,767.**—Of this amount, a sum of Rs. 10,921 represents the amount due from the Deputy Financial Secretary on account of cess collections made during December, 1938. This amount was received from him in January, 1939. The balance Rs. 4,846 was due from various persons in respect of produce, etc., sold and labour lent.

22. **Advance Account—Rs. 498.**—The details of the items making up the balance on this account are given in the balance sheet. The advances to the Superintendent of Dartonfield Estate and the Smallholdings Propaganda Officer were for sundry expenses and the amount shown against the Postmaster-General represents the amount deposited with him in respect of trunk call and other telephone fees.

23. **Accrued Interest on Investments—Rs. 1,643.**—This sum represents the amount of interest accrued for the year on the investments of the cash balances but not received during the year.

24. **Payments in Advance—Rs. 819.**—This sum represents the amounts paid during 1938 as telephone rentals, subscription charges and fees for publications in respect of 1939.

25. **Stock-in-Trade—Rs. 2,032.**—Of this amount, a sum of Rs. 1,433 represents the value of raw materials and finished rubber products, Rs. 178 the value of the balance rice in hand, and Rs. 431 the value of other stores in hand on December 31st, 1938.

26. **Loans for the Purchase of Motor Cars—Rs. 4,303.**—This amount represents the balance outstanding out of the loans of Rs. 2,700 and Rs. 2,650 granted to two members of the staff for the purchase of transport. The loans are being repaid in instalments with interest.

27. **Investment in Ceylon Government $3\frac{1}{2}\%$ Loan.—Rs. 25,000.**—This amount represents the face value of the Investment in the Ceylon Government $3\frac{1}{2}\%$ Loan 1937-62 and was verified by reference to the Stock Certificate. The price at which this loan was quoted in the market at December 31st, 1938, was, however, 101 $\frac{3}{8}$ at which rate the value of the investment would be Rs. 25,343.75.

28. **Cash Balances—Rs. 214,853.**—The receipts in support of the fixed deposits amounting to Rs. 160,000 were verified. The balances in current account with the National Bank of India, Limited, Colombo, were verified by reference to the Bank Certificates. The balance of cash in hand at December 31st, 1938, was not verified but a surprise verification of the cash in hand was made on March 4th, 1939.

V. SPECIAL

29. In 1937, a member of the Senior Scientific Staff, who was recruited from abroad, was granted one month's leave on full-pay in excess of the 8½ months' leave he was entitled to according to the terms of his service agreement. I pointed out that the officer could have been allowed the excess leave only on half-pay as part of the further leave of six months granted to Government officers on special grounds. The Board, nevertheless, has sanctioned the extra leave on full-pay although the liability of the Board was restricted to the terms of the officer's service agreement.

VI. GENERAL

30. The accounts were received quarterly up to March, 1938, and monthly since April, 1938, and were examined in this office. The office of the Board was visited once during the year and the books and accounts kept were checked and the cash in hand verified.

I am, Sir,
Your Obedient Servant,
(Sgd.) O. E. GOONETILLEKE,
Auditor-General.

Audit Office,
Colombo, *9th March*, 1939.

Revenue Account for the Year ended 31st December, 1938.

Dartonfield Estate.

Dr.						Cr.
To Expenditure :—	Rs.	cts.	Rs.	cts.		Rs.
General Charges ...	5,145	36			By Sale of Rubber (71,218 lbs.) and Coupons	
Upkeep	866	45				34,309 84
Cultivation... ..	1,530	19				
Collection	3,395	51				
Manufacture	3,594	95				
Distribution	926	30	15,458	76		
" Balance transferred to Revenue Account ...			18,851	08		
	Rs.		34,309	84		Rs.
						34,309 84

Nivitigalakele Experiment Station.

Working Account for the year ended 31st December, 1938.

Dr.							Cr.
		Rs.	cts.	Rs.	cts.	Rs.	cts.
To Expenditure :—				By Sale of Produce :—			
General				Rubber (21,565 lbs.)			
Charges Rs. 1,566 97				and Coupons ...	5,820	34	
Upkeep „ 3,919 70	5,486	67		Planting Material ...	7,821	60	
				Cover Crop Seed ...	89	41	13,731 35
Upkeep of Nurseries	2,230	21					
Collection and distribution of Budwood ...	872	09					
Collection of Cover Crop Seed ...	42	80	8,631 77				
„ Balance transferred to Revenue Account ...			5,099 58				
			Rs. 13,731 35			Rs. 13,731 35	

Manufacture of Vulcanised Products.

Trading Account for the year ended 31st December, 1938.

Dr.							Cr.
		Rs.	cts.	Rs.	cts.	Rs.	cts.
To Value of stock in hand on 1.1.38 :—				By Sales ...			
Raw materials ...	873	89		„ Stock at December 31st, 1938 :—			1,163 00
Finished goods ...	330	49	1,204 38	Raw materials ...	850	52	
„ Purchase of raw materials ...			423 84	Finished goods ...	572	16	1,422 68
„ Wages ...			517 30	„ Loss transferred to Revenue Account ...			205 28
„ Fuel ...			406 04				
„ Duty, Landing, Clearing charges and transport on raw materials, etc. ...			126 10				
„ Other Charges ...			113 30				
			Rs. 2,790 96			Rs. 2,790 96	

Capital Account as at 31st December, 1938.

GENERAL BALANCE SHEET AS AT 31st, DECEMBER 1938.

I certify that the above Balance Sheet presents a true and correct view of the financial affairs of the Rubber Research Scheme (Ceylon) as shown by the books on December 31st, 1938.

(Sgd.) E. RODRIGO,
Chairman,
Board of Management,
Rubber Research Scheme (Ceylon).

Working Account for the year ended 31st December, 1938.

(Sgd.) E. RODRIGO,
Chairman,
Board of Management,
Rubber Research Scheme (Ceylon).

Audited and found correct.

(Sgd.) O. E. GOONETILLEKE,

Auditor-General.

Audit Office,
Colombo, 9th March, 1939.

ESTIMATES FOR 1939.

(Adopted by the Board, October 27th, 1938.)

REVENUE

							Rs. Cts.
1.	Cess Collections	...	...	...	...	...	148,400 00
2.	Interest	...	...	...	...	...	3,725 00
3.	Sale of Publications	...	...	...	...	...	400 00
4.	Profit from Dartonfield	...	...	...	...	...	19,351 00
5.	Profit from Nivitigalakele	...	...	...	...	...	4,563 00
6.	Sundry Receipts	...	...	...	...	...	1,280 00
							Rs. 177,719 00

REVENUE EXPENDITURE

					Rs. cts.	Rs. cts.
1.	Administration of the Board :—					
	Travelling Expenses of Members	...	...			1,800 00
2.	Personal Emoluments :—					
	Senior Scientific Staff	...	...	...	69,697 00	
	Junior Scientific Staff	...	...	...	5,242 00	74,939 00
3.	Library and Publications :—					
	Library	...	...	...	1,000 00	
	Publications	...	...	...	2,500 00	3,500 00
4.	Smallholdings Work :—					
	Salaries and Allowances	...	...	...	15,539 00	
	Travelling and General Expenditure	...	...	...	9,478 00	25,017 00
5.	Laboratory :—					
	Equipment and Working Expenses	...	...	...	6,000 00	
	Furniture Replacements	...	...	...	50 00	6,050 00
6.	Field and Factory Experiments :—					
	Field Experiments	...	...	...	3,498 00	
	Factory Experiments	...	...	...	2,094 00	
	Budding Instruction	...	...	...	1,060 00	6,652 00
7.	Office :—					
	Salaries of Office Staff	...	...	...	8,405 00	
	Stationery and Office Equipment	...	...	...	2,500 00	
	Postages and Telegrams	...	...	...	2,000 00	
	Advertising	...	...	...	250 00	
	Telephone	...	...	...	1,000 00	
	Audit	...	...	...	600 00	14,755 00
8.	Travelling of Staff					6,300 00
	Carried over					139,013 00

					Rs. cts.	Rs. cts.
				Brought forward		139,013, 00
9.	Maintenance of Buildings :—					
	Laboratories and Offices	...	...	...	250 00	
	Bungalows	...	...	...	1,260 00	
	Water and Power Supply	...	...	...	350 00	1,860 00
10.	Miscellaneous Items Shared with Estate :—					
	Dartonfield General Charges	...	...	...	5,489 00	
	Nivitigalakele General Charges	...	...	...	1,613 00	
	Upkeep of Roads and Grounds	...	...	...	517 00	
	Factory Upkeep	...	...	...	413 00	
	Power Supply	...	...	...	2,294 00	10,326 00
11.	Contingencies :—					
	Contribution to London Advisory Committee	...	...	...	12,000 00	
	General Charges	...	...	...	750 00	
	Insurances	...	...	...	850 00	
	Staff Provident Fund	...	...	...	6,283 00	
	Passages	...	...	...	1,000 00	
	Entertainment Allowance	...	...	...	300 00	21,183 00
12.	Depreciation	...	...	...		23,000 00
					Rs. 195,382 00	

Rs. cts. Rs. cts.

CAPITAL EXPENDITURE**Buildings :—***Dartonfield :—*

One Junior Staff Bungalow 4,000 00

Nivitigalakele :—

Extension to Conductor's Bungalow 315 00 4,315 00

Equipment :—

Apparatus for Botanist and Soil Chemist ... 2,750 00

Almirah for Smallholdings Office ... 75 00 2,825 00

Immature Areas :—

Dartonfield 1,687 00

Nivitigalakele 2,915 00 4,602 00

Rs. 11,742 00

SUMMARY

Income 177,719 00

Expenditure :—

Revenue 195,382 00

Capital 11,742 00 207,124 00

Excess of Expenditure over Income Rs. 29,405 00



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